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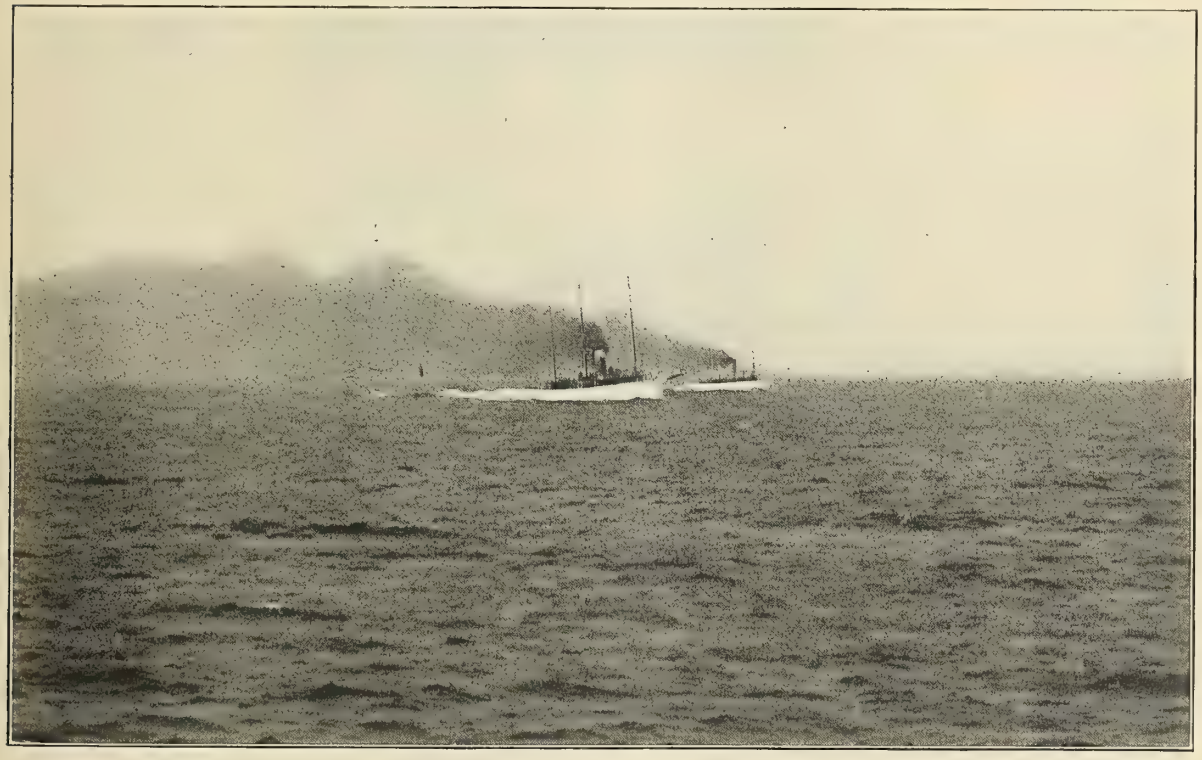
LYSISTRATA CUP RACE.

On June 18, Mr. H. H. Roger's steam yacht *Kanawha* defeated the *Hauoli,* owned by Mr. E. M. Smith, in a 60-mile race at sea, and thereby won the Lysistrata cup. The average speed of the winning yacht over the course was 19.90 knots, while that of the *Hauoli* was 19.53 knots. This trophy is the emblem of superior speed in the steam yacht as the America's cup stands for like perfection in the sailing yacht. There is, however, no handicap for time allowance in the rules governing the Lysistrata cup race. The yachts have to steam under ordinary cruising trim with the usual amount of coal and stores on board, and all boats must be carried except power launches, which may be omitted at the discretion of the owners. The launches were not carried by the competing boats.



THE RACE FOR THE LYSISTRATA CUP, THE KANAWHA LEADING THE HAUOLI SEVEN MILES FROM THE FINISH.

The course lay from Sandy Hook lightship south south-east 30 miles to sea and return,, or 60 nautical miles in all. At 1 hour 15 minutes the preparatory signal was given and when 15 minutes later the starting gun was fired the *Kanawha* crossed the line 4 seconds in the lead. Never during the race did the *Hauoli* take first place, although on the outward leg the race was very close. The two boats made a splendid run. There was a light southerly breeze blowing on the starboard bow, but the sea was smooth as a mill pond. At the outer mark the *Kanawha's* time was one and one-half hours exactly, which means she had covered the leg at exactly a 20-knot pace. Her turning circle was greater than the *Hauloi's* and it is estimated she lost a full half minute to the *Hauoli,* which turned 1 minute 26 seconds later. The wind was now on the port quarter, which made the draft a bit more sluggish, although the forced-draft fans on both boats were running full speed. Ten minutes after turning the *Kanawha* began forging ahead of her rival and from then on increased her lead. Amid the shrieking of the whistles of the observation fleet she crossed the line 3 minutes 29 seconds in the lead. These are the official figures:

	Start.	Turn.	Finish.	El. Tm.
	h. m. s.	h. m. s.	h. m. s.	h. m. s.
Kanawha	1 31 26	3 01 26	4 32 24	3 00 58
Hauoli	1 31 30	3 02 56	4 35 57	3 04 27

It is stated that the *Kanawha* burned 20 tons of picked

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Pocohontas coal and that the *Hauoli* burned 15 tons of hand-picked George's creek coal. Below are the principal dimensions of the two yachts:

	Kanawha.	*Hauoli.*
Length over all	227 ft. 3 ins.	211 ft. 3 ins.
" on water line	192 " 0 "	166 " 0 "
Beam, extreme	24 " 4 "	21 " 6 "
" on water line	23 " 8 "	20 " 10 "
Depth	15 " 0 "	12 " 0 "
Draft	11 " 6 "	9 " 0 "
Least freeboard	6 " 0 "	5 " 6 "
Probable displacement	580 tons	360 tons
Engines:	Twin-screw, triple-expan. 3 cylinders	Sing.-screw, triple-expan. 4 cylinders
Cyl. diams.	14 1-2, 24, 42 ins.	17, 26 1-2, 30, 30 ins.
Stroke	24 ins.	21 ins.
Revolutions	305	290
Boilers:	4 Seabury water tube,	4 Almy water tube
G. S.	179 sq. ft.	133 sq. ft.
Pressure	250	250
Propellers: Diam., approx.	7 ft. 4 ins. 4 blades,	6 ft. 8 ins. 3 blades
Pitch, approximate	9 ft. 0 ins.	9 ft. 6 ins.
Material	Man. bronze,	Man. bronze

The Lysistrata cup is now owned by Mr. Rogers, as he has won it twice in successive years, last year defeating the steam yacht *Noma*.

THE LYSISTRATA CUP, WON BY THE KANAWHA.

[Photograph by New York Herald.]

Test of the Submarine Boat Fulton.

The Holland torpedo boat *Fulton*, which arrived at the torpedo station, Newport, R. I., May 26, has undergone a thorough test. She has had surface, underwater, and endurance trials, and all under the direction of naval officers detailed for that purpose.

On June 6, the *Fulton* was taken to a point off Point Judith, and from there went submerged through a ten-mile course. The periscope was used successfully, the submarine coming to the surface directly between two targets off Block Island, which marked the end of the course. The ten miles were covered in one hour and twenty minutes. There was never a more perfect and searching test of what a submarine can do than this one.

The feature of the tests, and the one which attracted the most attention was that which took place the night of the 6th and the morning of the 7th, when the *Fulton* was submerged for twelve hours without coming to the surface, which was to prove her habitability. During this time the officers and men to the number of nine experienced no discomfort whatever. The meals were cooked on an electric stove, and they ate them as heartily as if they had been served in the open air. Fresh air from compressed air tanks was forced into the compartment occupied by the crew once every four minutes, in conformity with the instructions of the inspection board. At no time did the crew feel any ill effects from lack of air or too much air. Members of the crew say their stay under water was most pleasant and that they slept as comfortably as they would in their own beds. They could plainly hear the noise made by passing steamboats.

An eight-hour continuous sea test ended the *Fulton's* test, in which she is stated to have accomplished all the owners have claimed for her. The official report will be awaited with interest.

GOVERNMENT DREDGES FOR NEW YORK HARBOR.

Two large suction sea dredges intended for deepening the channel in New York harbor are now building by the Maryland Steel Company, Sparrows Point, Md., for the government. The dredges were designed by Capt. E. O. Patterson, who has superintended their construction for the Engineers' Department, United States Army. Three years ago this company built two large suction dredges for the Metropolitan Dredging Company for use in New York and plans of these were given in the June issue, 1901, of MARINE ENGINEERING. The present boats, while somewhat smaller than the former vessels, are of an entirely different design. The machinery for propulsion and dredging is located amidships. There are two large centrifugal pumps, each connected to a suction pipe pivoted to swing overboard vertically, one on the port and the other on the starboard side. These pumps discharge into either or both of the two large bins, one located forward and the other aft of the machinery.

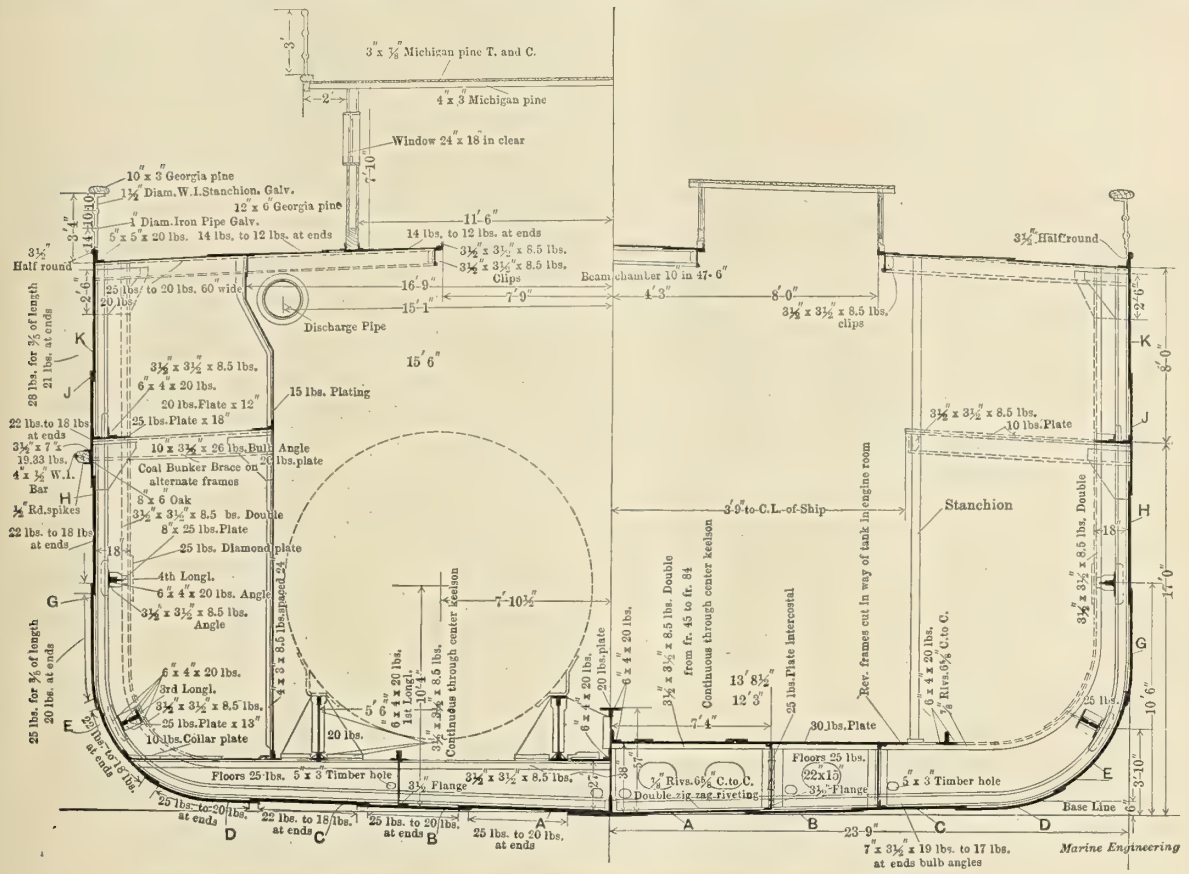
The method of dredging is that the ship proceeds under her own steam slowly over the ground with suction mouth dragging on the bottom. The mud, sand and water are lifted through the pipe by the pumps and discharged into the bins, the water drains overboard. The capacity of the pumps working under a 16-foot head is 95 cubic yards of water per minute. It is estimated that the bins may be filled in one hour, then the suction pipes and drags are raised by means of winches and gearing on the deck and the vessel proceeds to sea and her load is discharged by opening gates in the bottom of the bins. The gates are then closed and the ship proceeds back to her station.

As seen from the plans, the dredges are similar in appearance to ocean steamers, for it is intended that they remain at work during good and bad weather. Much of the channel must be dredged in the open sea. Vessels are expected to remain at their station one week or ten days before returning to port for coal and provisions.

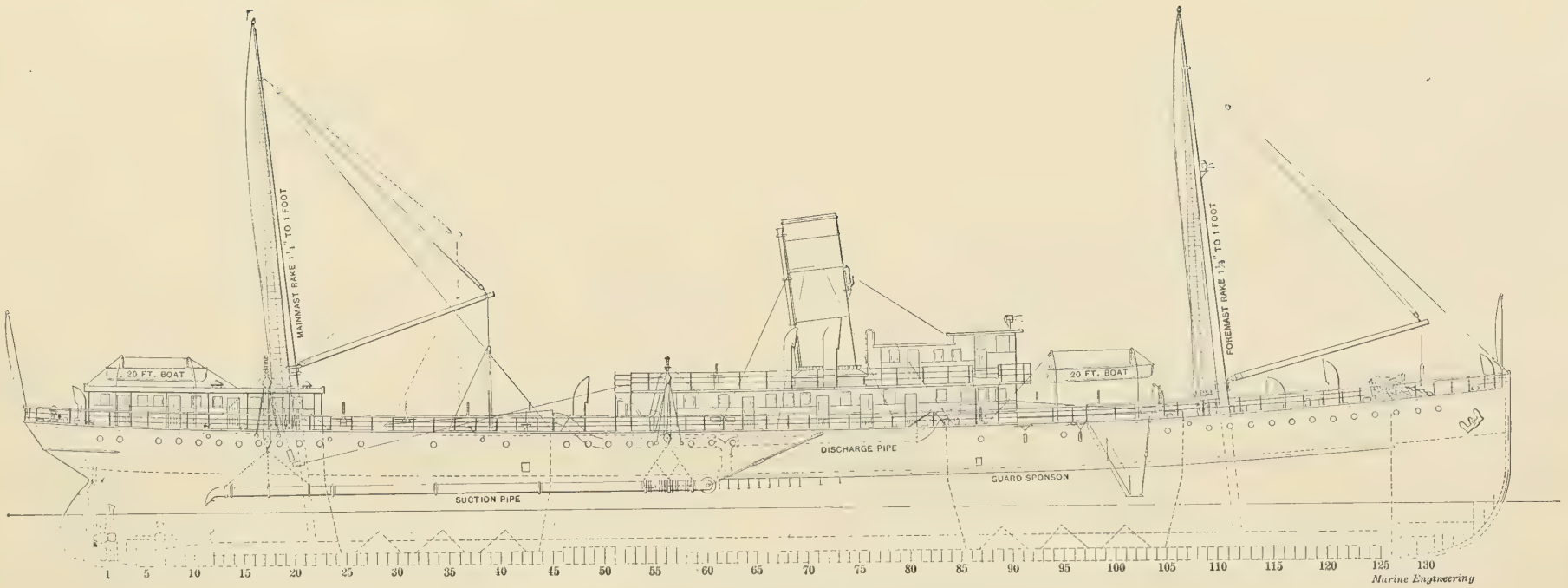
HULL CONSTRUCTION.

The hull is built of mild steel throughout. The stem is forged and the stern post is of cast steel. The rudder is of single plate type, with forged steel stock and arms. The extention stock is a separate forging with palm on lower end bolted to the palm on head of stock. The frames are bulb angles spaced 24-inch centres, with reverse bar on top of floors only. The center keelson is continuous from forward peak to after peak bulkhead and extends above the floors. A bulb angle beam is on every frame at main deck, and at lower deck forward and aft of sand bins, in after-end of engine room and alongside of bins.

The sand and mud is carried in two large bins, one forward and one aft, each being 44 feet long and 39 feet 6 inches wide. The side bulkheads of bins are


3" x 1½" Michigan pine T. and C.
4" x 3" Michigan pine
Window 24" x 18" in clear
10" x 3" Georgia pine
1¼" Diam. W.I. Stanchion, Galv.
12" x 6" Georgia pine
1" Diam. Iron Pipe Galv.
5" x 5" x 20 lbs. 14 lbs. to 12 lbs. at ends
3½" Half round
25 lbs. to 20 lbs. 60" wide
20 lbs.
Discharge Pipe
3½" x 3½" x 8.5 lbs.
6" x 4" x 20 lbs.
20 lbs. Plate x 12"
15 lbs. Plating
25 lbs. Plate x 18"
22 lbs. to 18 lbs. at ends
10" x 3½" x 26 lbs. Bulb Angle
20 lbs. plate
Coal Bunker Brace on alternate frames
8" x 6" Oak
3½" x 3½" x 8.5 lbs. Double
8" x 25 lbs. Plate
25 lbs. Diamond plate
4th Longl.
6" x 4" x 20 lbs. Angle
3½" x 3½" x 8.5 lbs. Angle
3rd Longl.
25 lbs. Plate x 13"
10 lbs. Collar plate
20 lbs.
Floors 25 lbs. 5" x 3" Timber hole
3½" Flange
25 lbs. to 20 lbs. at ends
22 lbs. to 18 lbs. at ends
Continuous through center keelson
14 lbs. to 12 lbs. at ends
3½" x 3½" x 8.5 lbs. Clips
Beam chamber 10 in 47.6"
Rev. frames cut in way of tank in engine room
3'9" to C.L. of Ship
Stanchion
30 lbs. Plate
25 lbs. Plate Intercostal
6" x 4" x 20 lbs. 5/8" Rivs. 6" C. to C.
Floors 25 lbs. (22" x 15")
5" x 3" Timber hole
Base Line
7" x 3½" x 19 lbs. to 17 lbs. at ends bulb angles
Marine Engineering

MIDSHIP SECTION OF GOVERNMENT DREDGES MANHATTAN AND ATLANTIC, FOR USE IN NEW YORK HARBOR.


20 FT. BOAT
MAINMAST RAKE 1½" TO 1 FOOT
20 FT. BOAT
FOREMAST RAKE 1½" TO 1 FOOT
DISCHARGE PIPE
GUARD SPONSON
SUCTION PIPE
1 5 10 15 20 25 30 35 40 45 50 55 60 65 70 75 80 85 90 95 100 105 110 115 120 125 130
Marine Engineering

SAIL PLAN OF OCEAN-GOING SUCTION DREDGES MANHATTAN AND ATLANTIC.

thus 4 feet inside of side line of ship. These bulkheads as well as the end bulkheads of bins are stiffened by bulb angles spaced 24-inch centers, well bracketed at lower deck and braced below knuckle line by bulb angle braces. In addition to the vertical stiffeners, the end bulkheads are stiffened by horizontal channels, both above and below knuckle line. Heavy tie rods with turnbuckles in middle connect the horizontal stiffeners on end bulkheads to each other.

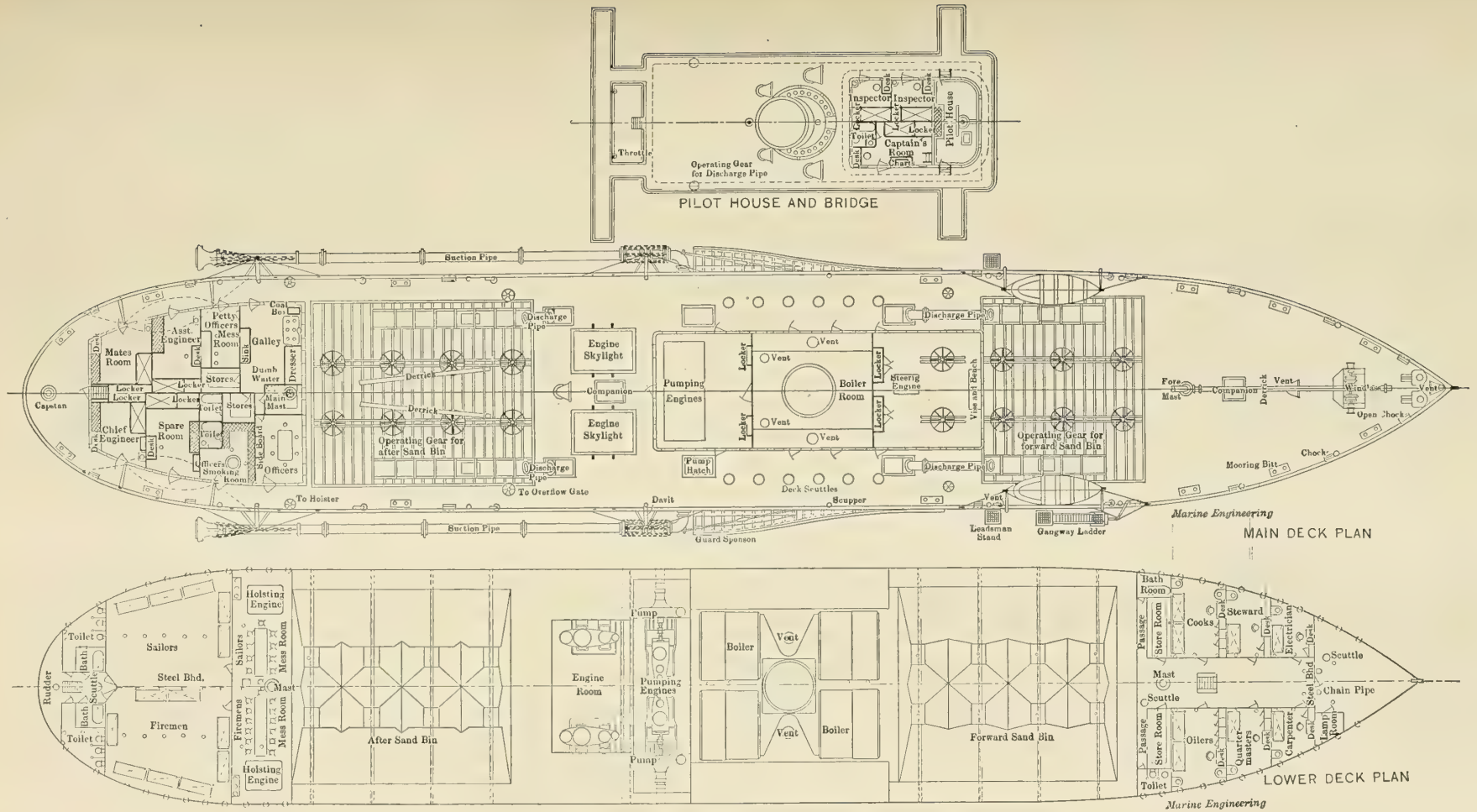
The capacity of these bins is 2,000 cubic yards. Each bin has eight openings, through which mud is discharged, four on each side of center line. These are steel castings riveted to floors, bin plating, and fore and after between floors, and are rectangular in shape. The openings are closed by cast steel gates, hinged on side nearest center line, and are operated by means of a rod, connected to lug in center of gate, which is raised and lowered by a large wheel above bins at the level of the main deck.

There are four watertight bulkheads spaced as follows: A forward collision bulkhead, one alongside of forward bin, between engine and boiler rooms and after peak. The space under the propelling engines is fitted as a double bottom to carry fresh water. Coal bunkers are alongside boilers and fire room and have stowage capacity for 335 tons.

The ship is provided with a 9 by 9-inch steam windlass, two 10 by 12-inch steam winches for hoisting suction pipes and a 7 by 8-inch steam capstan, all of Hyde make; the steam steering engine is of Williamson make with cylinders 6 by 6 inches. Two water tanks of 2,000 gallons capacity each, are located in after hold with all connections to pumps, etc.

The main rail is of Georgia pine 10 by 3 inches, supported by solid forged stanchions riveted to sheer strake. The two intermediate rails are of 1-inch wrought iron pipe. On top of the house and around bridges is a railing composed of three lines of 1-inch wrought iron pipe, supported by solid forged stanchions. A fender of 6 by 8-inch oak is carried from forward end of suction pipe to forward collision bulkhead. The after end is made in sponson shape to protect the pipe.

The crew have large, roomy quarters in after 'tween decks, together with mess-rooms, pantry and toilet rooms. The winches for operating suction pipe are



DECK PLANS OF OCEAN-GOING SUCTION DREDGE, BUILT BY THE MARYLAND STEEL COMPANY.

also on the lower deck aft. The petty officers have quarters forward in the 'tween decks, and are provided with toilet rooms and large sleeping quarters. The officers have rooms in a large house on the main deck aft. In this house are also a large smoking room, officer's mess-room, pantry and galley. The roof is extended to the side of ship, making a good shade deck.

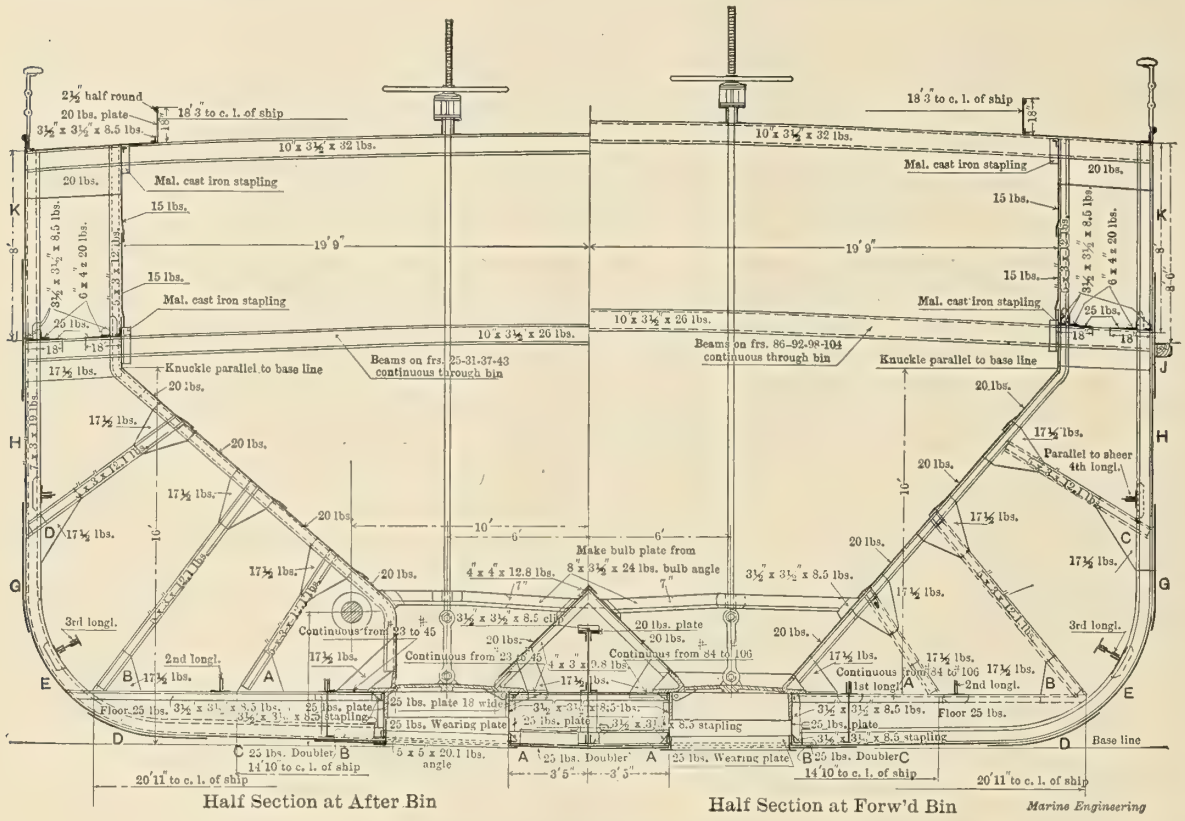
In the house around stack are a large machine shop, steering engine room and space above pumping engines. The pilot house and captain's room are on top of this house.

All houses are sheathed outside with Michigan pine, and inside with cherry, and are fitted with window sashes of hard wood, with thick glass. All state rooms and mess-rooms are provided with inside blinds of cherry. Floors are all of selected oak.

All crew's quarters are finished in tongue and grooved

cypress, and fitted with pipe berths of latest pattern. The ship is schooner rigged, having two pole masts of Oregon pine, the foremast being provided with one boom and the main mast with two.

the two pumping engines are of similar design with cylinders 16 and 32 inches diameter with a stroke of 18 inches. The condensers are independent, with 4011 square feet of cooling surface and an independent con-



SECTIONS AT AFTER AND FORWARD BINS IN THE SUCTION DREDGE FOR NEW YORK HARBOR.

MARINE ENGINEERING DATA CARD. **JULY, 1904.**

NAME—Manhattan and Atlantic. NATIONALITY—American. TYPE—Ocean suction dredges.
LAUNCHED—1904. BUILDERS—Maryland Steel Co. OWNERS—U. S. Army.

Length overall	288 ft. 0 ins.
" between perps	274 " 0 "
Beam, molded	47 " 6 "
Depth, "	25 " 0 "
Load draft	18 " 0 "
Displacement, load draft	5,266 tons
Dead-weight carrying capacity	3,050 "
Block coef	.786
Midship section area	826.5 sq. ft.
Wetted surf	19,677 " "
Speed, loaded, estimated	10 knots
Propelling Engines: Number	two
Type	compound
Valves	piston on H. P.
Cylinder diameters	22 and 44 ins.
Stroke	30 "
Condensed surface	4,011 sq ft.
R. P. M., designed	100
I. H. P., "	1,800
Propellers: Number	two
Material	cast iron, 4 blades
Diameter	9 ft 6 ins.
Pitch	12 ft. 0 ins.
Area, developed	48.54 sq. ft.
Dredging Machinery:	
Centrifugal pumps	two
Pipes, suction and discharge, diam	20 ins.
Engines	2 sets, compound direct connected
Cylinder diameters	16 and 32 ins.
Stroke	18 "
R. P. M.	220
Capacity each, 16 ft. head	95 cu. yds. water per min.
Bins, two, capacity each	1,000 cu. yds.
Condensed surface	1,502 sq. ft.
Boilers: Number	four
Type	single-end Scotch
Pressure	125 lbs.
Diameter	14 ft. 0 ins.
Length	12 " 0 "
Draft	natural
Furnaces, each	three
Least diameter	42 ins.
G. S., total	294 sq. ft.
H. S., "	10,704 " "

MACHINERY.

The propelling machinery consists of two direct-acting inverted cylinder compound engines, having cylinders 22 and 44 inches diameter, with a stroke of 30 inches, and denser for pumping engines has 1501 square feet of surface. The high pressure cylinders are provided with piston valves and the low pressure cylinders with slide valves. The pumping engines are on a raised plat-

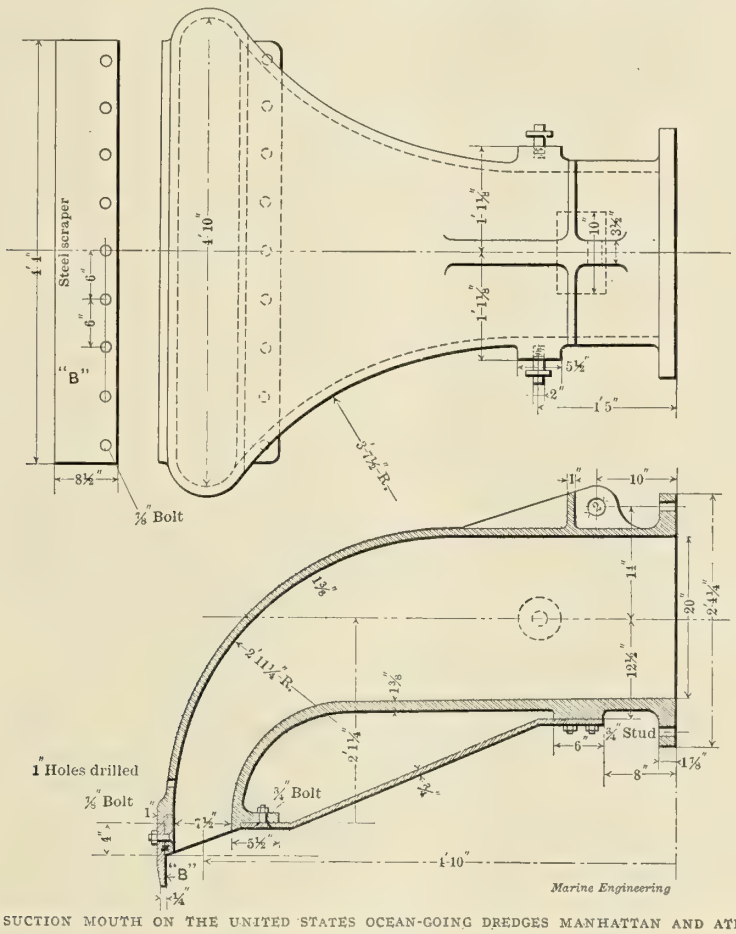
form, underneath which are the pumps for all purposes. One centrifugal pump, 12-inch runner, and driven by an 8-inch engine supplies circulating water for two condensers. A twin air pump with cylinders 16 and 30 inches of 18-inch stroke is fitted to each condenser. The two main feed pumps are 9 and 6 by 10 inches duplex. The bilge is of same type and dimensions; the fire pump is of duplex 14 and 8 inches by 12 inches; the feed, 7 1-2 and 4 1-2 by 8 inches duplex. The auxiliary air pump is a 9 and 14 1-2 by 8-inch simplex and the auxiliary circulating pump is 8 inches diameter driven by a 6 by 6-inch engine. All pumps are of Blake type.

The propellers are of cast iron 9 feet 6 inches diameter and 12 feet pitch, four bladed with a developed area of each 48.54 square feet.

Steam is supplied by four Scotch boilers, 14 feet diameter by 12 feet long, built for 125 pounds steam pressure, working under natural draft. Each boiler has three 42-inch furnaces of Morison type. The total grate surface is 294 square feet, and the total heating surface is 10,704 square feet. There is one double stack extending 32 feet above top of house, the outer stack being 10 feet 6 inches diameter.

The two dredging pumps are of centrifugal type, having suction and discharge 20 inches diameter. These are direct connected to pumping engines and draw the dredged material through the suctions 20 inches diameter, one on each side of ship. The drags, or mouths of the suction pipes, are of cast steel with mouths widened out. The upper end of suction pipes is provided with a piece of hose 10 feet long, connected to steel casting. At each end of the suction pipe, which is 98 feet long, are chain slings connected to falls on 8-inch davits. The hauling part of these falls is led to winches on lower deck aft.

The mud is distributed to bins through the discharge pipes, which are carried under main deck to a point near bins, where they come through the deck and discharge into sluices, with gates at intervals. A large Y pipe is bolted to top of pump with valve, which distributes the flow of material to either bin.



DRAG OR SUCTION MOUTH ON THE UNITED STATES OCEAN-GOING DREDGES MANHATTAN AND ATLANTIC.

An electric lighting plant is installed on lower deck in engine room, for 140 16-c. p. incandescent lamps, and three 50-c. p. for side and masthead lights. A search light of 25 amperes capacity is located on pilot house. The two-wire system is used for all lights. Crew of 60 men, all told.

Monthly Shipbuilding Returns.—The Bureau of Navigation reports 103 vessels of 24,691 gross tons built in the United States and officially numbered during the month of April, 1904. The largest steel steam vessels included in these figures are: *City of Columbus*, 5,433 gross tons, and the *Missouri*, 2,434 gross tons.

MOTOR BOAT RACES ON THE HUDSON.

The anticipated interest in fast motor boats has been fully realized and two races for launches and auto boats have already been held this season, under the general direction of the American Power Boat Association. Several new auto boats have appeared this season and, although of practically a new type, have already made a creditable showing in point of speed.

The first event was held under the auspices of the Manhasset Bay Yacht Club of Port Washington, Long Island, and the second event was started from the Columbia Yacht Club house, foot of Eight-sixth street, on the Hudson, New York City. In this latter race were many entries in all classes, and the races proved quite a test of endurance. Of the automobile type there appeared the *Hard Boiled Egg*, owned by William K. Vanderbilt, Jr., which is 35 feet on the water line, 40 feet over all and fitted with a 60-horse-power Mors engine. The *F.I.A.T.*, No. 1, also appeared. She is 30 feet on the water line, 35 feet over all, and fitted with a 35.17-horse-power engine of the same name. She went through the race without an accident and led the others of her class. The boat is owned by Mr. T. N. Tangerman. The *Shooting Star*, owned by Mr. H. A. Lozier, Jr., is fitted with a Lozier engine of 27.14 horse power.

Mr. George W. C. Drexel's *Alert*, a new boat with a 6-cylinder Speedway engine, was entered, although she had just come from the builders without much tuning up. She became disabled on the first run and withdrew, though repairs were easily made afterward, and in an exhibition spin she showed much speed. Mr. Frank Seaman's *Water Lily*, 47 feet 5 inches over all and equipped with a Speedway engine of 40 horse power, also had temporary trouble with the machinery and was the last of her class to finish. The *Japansky*, owned by Mr. J. H. Waldorf, having a Speedway engine of 40.99 horse power, and the *Standard*, the property of Mr. C. C. Riotti, fitted with a Standard engine of 110 horse power, completed the list of prominent auto boats. The *Standard's* performance was excellent and she was the winner of her class. The classification and rating of the boats are given in the table following.

Two courses were laid out, the longer from off the club house to a mark opposite 155th street, then down the river to a stake off 66th street and return, the distance being eight nautical miles. Classes B, C, D, H, I, and J covered it twice, sixteen miles. All the auto boats were to cover it four times, thirty-two miles, but the *Shooting Star*, the *Hard Boiled Egg* and the *F.I.A.T.* went four times over the shorter course, the up-river turning mark being off 129th street, making twenty-four miles. Class K covered twelve miles, while the *Standard*, the *Japansky*, *Alert* and *Water Lily* took the longer course, thirty-two miles. Of these the *Standard* only finished without mishap. The full summary follows:—

Classes B, C, D.—Course 16 nautical miles. Start, 2h. 35m.

Boat and Owner.	Finish.	Elapsed Time.	Corrected Time.
	h. m. s.	h. m. s.	h. m. s.
Queen Bess, R. N. Stevens.	4 34 35	1 59 35	1 42 10
Regina, D. L. Clayton.....	4 37 30	2 02 30	1 47 02
Senta, F. G. Mead.....	4 46 07	2 11 07	1 51 41
Aletes II., R. C. Fisher....	4 31 39	1 56 39	1 56 39
Getty, Morris Vail.....	5 15 48	2 40 48	2 54 11

The *Queen Bess* is the winner, with the *Regina* second and the *Senta* third.

The *Queen Bess* and the *Aletes* II. are equipped with Standard engines, the *Regina* with the Speedway, the *Getty* with the Kepp and the *Senta* with the Howard.

Classes H, I and J.—Course 16 nautical miles. Start, 2h. 40m.

San Toy, W. H. Barrow....	4 14 04	1 34 04	1 33 01
Ardis, R. M. Haddock.....	4 14 34	1 34 34	1 34 34
Kaa, J. J. Amory.....	Did not finish.		

The *San Toy* is the winner.

Classes K and L.—Course 12 nautical miles. Start, 2h. 45m.

Nada, C. A. Godshalk.....	4 09 27	1 24 27	1 24 17
Kotic, C. A. Paine.....	Did not finish.		

The *Nada* is fitted with a Giant engine.

Classes P, Q and R.—Automobile boats; 32 nautical miles. Start, 2h. 50m.

Standard, C. C. Riotto.....	4 31 27	1 41 27	1 41 27
Japansky, J. H. Waldorf...	5 11 33	2 21 33	2 19 00
Alert, G. W. C. Drexel....	Did not finish.		

The *Standard* is the winner. Her racing length is 86.05 and the *Japansky*, 70.35.

Classes S, T, V.—Automobile boats, 24 nautical miles. Start, 2h, 55m.

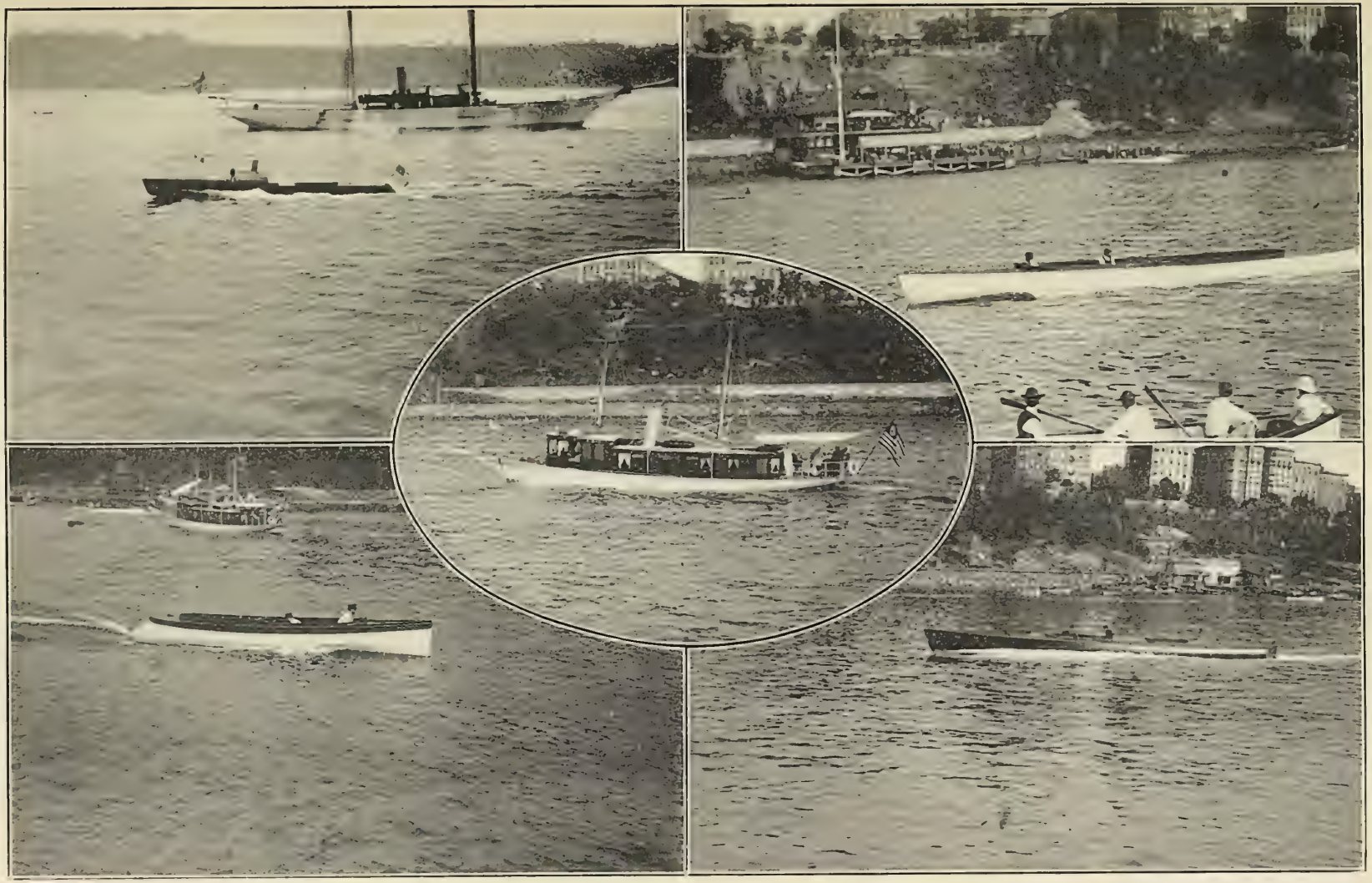
F.I.A.T., C. H. Tangerman..	4 26 07	1 31 07	1 23 24
Shooting Star, H. A. Lozier, Jr.....	4 27 01	1 32 03	1 30 55
Hard Boiled Egg, W. K. Vanderbilt, Jr.....	4 32 21	1 37 21	1 37 21
Water Lily, Frank Seaman.	Did not start in her class.		

The *F.I.A.T.* is the winner, the *Shooting Star* second, and *Hard Boiled Egg* third.

The *F.I.A.T.* has an engine of that name; the *Shooting Star*, the Lozier, and the *Hard Boiled Egg* with the Mors.

The *Standard* covered the course of 32 nautical miles in 1h. 41m. 27s. and the *F.I.A.T.* the 24 mile course in 1h. 31m. 7s.

Pacific Mail Steamship Manchuria.—The steamship *Manchuria*, the latest addition to the Pacific Mail Steamship Company's fleet, to engage in the San Francisco-Orient trade, sailed from New York on June 9, bound for San Francisco. The *Manchuria* is a sister ship to the *Mongolia* and has been completed at the yards of the New York Shipbuilding Company, Camden, N. J. Following are the principal dimensions: Length over all, 615 feet 8 inches; breadth, 65 feet; depth to shelter deck, 51 feet 3 inches; load draft, 33 feet 6 inches; displacement, 27,000. A full description of this vessel was given in MARINE ENGINEERING in April, 1904.



WINNING GASOLINE AUTO BOATS AND LAUNCHES, ENTERED IN THE RECENT HUDSON RIVER RACES.

F. I. A. T. No. 1, winner in 24-mile race.

The Queen Bess, first in 16-mile race, Class B. C. D.

Shooting Star, second in 24-mile race.

The Standard, which won the 30-mile event.

Memories of 1865.

BY FREDERICK C. RUSSELL.

Nearly forty years have passed since the United States monitor *Nantucket* closed her active service in the South Atlantic squadron, off Charleston, S. C. I was at that time acting second assistant engineer, and, believing that a few items from those days may be of interest to the modern engineer, I select from our log book the run from Port Royal to Philadelphia.

On Monday, June 12, 1865, we find all hands getting the ship ready for sea, men coaling ship, and getting in supplies; a gasket is driven under the turret, and the turret lowered as far as possible. At 4 P.M. started fires under the starboard boiler, and by request of our chief a few of the deck hands were detailed for the fire room, to pass coal on the passage north.

Tuesday, June 13, opened fine, with wind southwest and a slight swell. Between 10 and 11 A.M. we left Port Royal in tow of the U. S. S. *Fahkee*. The monitor would follow nicely in tow as long as our engines were running, but if for any reason our propeller was stopped the ship became like a log, almost unmanageable. When running alone, at full speed, she would respond easily to her helm, and turn in almost her own length.

We were but a short distance out from Port Royal when our condenser became heated and we were unable to form a vacuum, so we ran the engines high pressure to Charleston bar, about fifty miles, and anchored outside the lightship at 10:40 P.M. We anchored as far outside as possible, showing no lights. We were bound home and did not care to be noticed by the flagship, as that would mean an order to run inside for repairs, and we felt competent to make our own repairs. The writer had the watch from 8 P.M., and on the ship's coming to anchor commenced to overhaul air pump and condenser, putting in new rubber valves and making new joints. The temperature in the engine room ranged from 135 to 140 degrees.

When the relief engineer came on, at midnight, we arranged to both work the rest of the night, so that we could be off in the morning before the admiral should call us into the fleet. So by 4 A.M., June 14, we had both heads on the air pump and a turn of packing around port trunk of main engines. Of course the force of firemen and oilers in each watch helped in lifting and passing materials. At 6:20 A.M. we started ahead in tow of the *Fahkee* again. At 7:50 A.M. the main bearing became heated. Running water failed to cool it, obliging us to stop and slack up on it a little. At 3 P.M the air-chamber joint of the main feed pump blew out; stopped engines again and made a new joint. Following this the starboard donkey pump began to work badly, and a leak manifested itself at the stern bearing; a little setting up on the gland stopped that, however. The sea was comparatively smooth thus far, which was much in our favor. On this day, at 11 A.M., we made Cape Romain light bearing N.N.W., distant 10 miles; at meridian the light was bearing N.W.; temperature in the engine room 132 to 134 degrees.

On June 15 the sea was smooth in the forenoon; in the afternoon the wind came around northeast and a long swell was rolling in from the gulf stream. There were appearances of squally weather. The ship was pitching some and the engines thumping badly. At 1:20 P.M. the port cut-off eccentric straps worked loose; stopped engines for about half an hour to set up on them and get them working smoothly again. Temperature of engine room 130 to 134 degrees.

On June 16 there was a heavy sea running from the northeast and in the middle of the day stopped engines to key up on crank bearing and connecting rods and in a short time we had everything again working well. About noon we were off Cape Hatteras and altered our course more to northward. Temperature of engine room 121 to 135 degrees.

June 17 opened fine with a smooth sea. At 10 A.M. a leak started in port boiler in No. 5 tube box. Temperature of engine room to-day 124 to 130 degrees.

June 18 was Sunday, and fine weather continued. Very early this morning, between 12 and 1, made Fenwick island light bearing west, distant 12 miles. At 3 A.M. made Cape Henlopen light bearing northwest, distant 15 miles. At 4:30 A.M. saw the land bearing west. At 5 A.M. the charges were fired from the 15-inch and the 11-inch guns; they were to go up the Delaware "free of charge." In some way the turret was not turned far enough to clear our boats and the charge from the 15-inch gun stove the port side of our second cutter. At 10:30 A.M. passed Brandywine shoals. Between 5 and 6 P.M. passed Fort Delaware, and at about 9 P.M. came to anchor below Chester, Pa., on the Delaware. It seemed to us that we had been getting home on the installment plan, a little at a time, and this day could not close without one more event, viz.: our windlass got out of order; it was under cover, and hung from the deck beams, and we had considerable trouble to "let go the anchor." On this job our blacksmith was called into service.

On Monday, June 19, we got under way in the morning, steamed to Fort Miflin and discharged shot and shell all day. At 8 P.M. the leak in our port boiler had increased so that we could not keep the water at the proper level, and accordingly hauled fires from the boiler and blew out the water.

The next day, early in the morning, we steamed up the river with one boiler, and came to anchor off the Philadelphia navy yard, near the *Passaic* and *Lehigh*.

On Wednesday, June 21, 1865, the ship was put in order to go out of commission.

International Engineering Congress.—On October 3 to 8, 1904, an international engineering congress will be held at St. Louis, under the auspices of the American Society of Civil Engineers. Among the papers to be presented are those on the following subjects: harbors, natural waterways, artificial waterways, lighthouses and other aids to navigation, traffic on improved waterways, substitution of electricity for steam as motive power, manufacture of steel, tests of materials of construction, pumping machinery, dredges, their construction and performance, steam turbines, dry-docks, wharves and piers. Under the heading of naval architecture, papers will be presented by Rear-Admiral W. L. Capps, chief constructor, U. S. N., and Sir William H. White, late director of naval construction, England. Professor W. F. Durand, of Cornell university, and Mr. M. Maynard, chief engineer of the French line, will present papers under the general heading of marine engineering.

Foreign Types of Steam and Electric Harbor Cranes.

BY FRANK C. PERKINS.

The steam, hydraulic, and pneumatic crane is of the greatest importance at every large harbor, and the electrically-operated crane for dock work is fast becoming an indispensable mechanism for this class of work. The accompanying illustration, Fig. 1, shows a 4-ton electric crane for the Table Bay harbor, constructed in England by Stothert and Pitt, Limited. It is a movable crane operating upon a double track, of the portal type, with both rails on the same level. Two stationary types of harbor cranes are to be seen in Figs. 2 and 3, constructed at the works of the Duisburger Maschinenbau-Actien-Gesellschaft, formerly Bechem and Keetman, at Duisburg, Germany. The former is a hammer crane of 150 tons normal load and tested to 200 tons. It is located at Krupp's Germaniawerft at Kiel, and the load is moved to various points by the traveling crab of the hammer crane, instead of by raising and lowering the jib in the other type of crane illustrated. The Krupp crane, it is claimed, has the advantage that less power is required for the driving of the crab and greater speed can be obtained. The masses moved are smaller and the efficiency of transport is higher. The revolving crane post is constructed of lattice girders and is surrounded by the supporting frame which transfers the balancing momentum of the crane to the foundations.

At an equal distance of the crane post from the head of the quay the three lateral supporting frames take up the least room and admit passing underneath of one or two lines of rails. The crane post rests on a roller path with 28 conical rollers which run on wrought-steel rails let into cast-steel ring plates.

In the crab are mounted, besides the traveling gear, two sets of lifting gear, each having a pair of drums, of which the larger one carries a maximum load of 150 tons, while the auxiliary lifting gear possesses a capacity of 45 tons. The driving is accomplished by a set of three motors, which drive an equal number of pairs of worm wheels revolving in opposite directions, the wheels of which drive the cogwheels at the end. The motors are connected by means of clutch couplings with the large or small lifting gear, as may be required.

On a level with the driver's platform, the revolving gear is mounted on the bottom girder of the jib and acts upon a rod rail which surrounds the upper ring bearer. The speed and friction momenta offering resistance to the revolving are thus principally taken up by the supporting frame resting on a wide basis and transferred to the foundations. A light scaffolding is also provided on the jib of the crane, which carries a

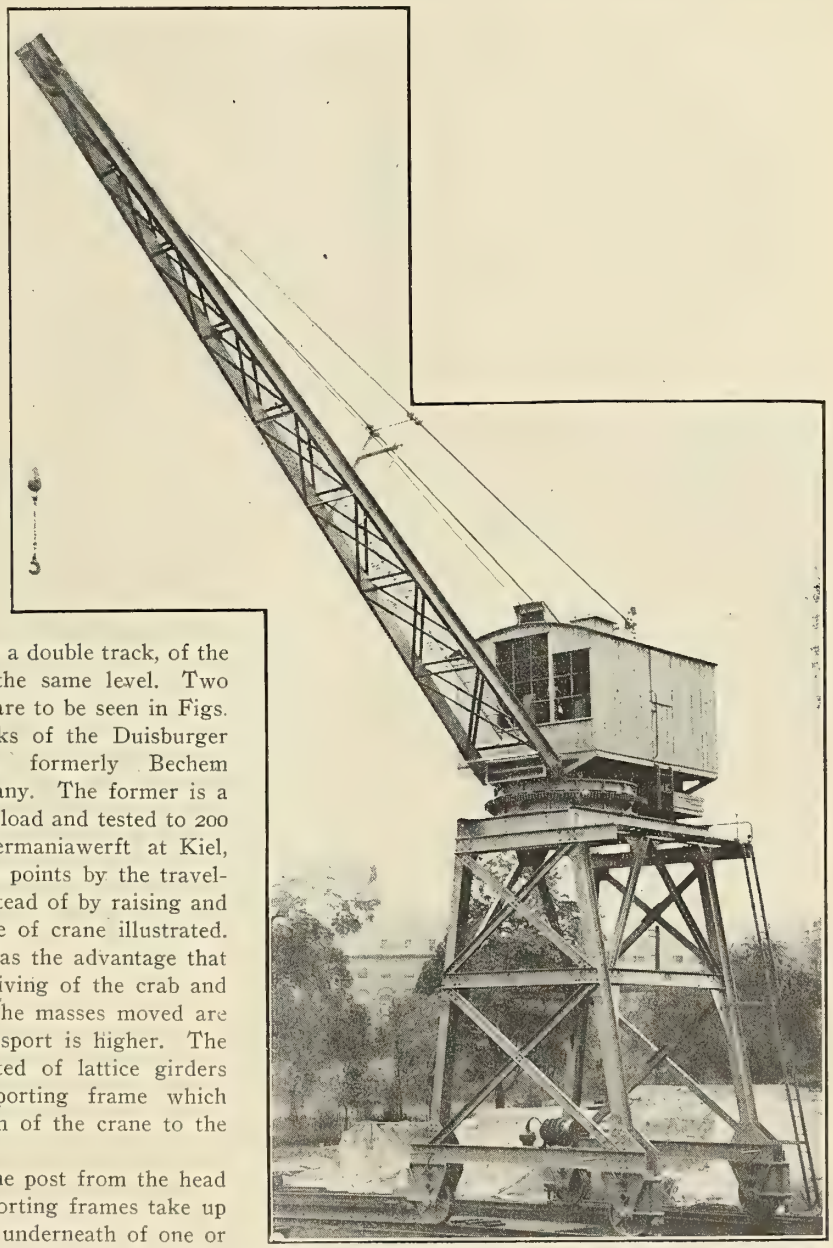


FIG. 1.—4-TON ELECTRIC CRANE, FOR TABLE BAY HARBOR.

traveling crab and electric winch which is meant for speedily lifting loads up to one ton. The crane is operated by a direct current of 550 volts pressure, the crane revolving through a radius of 35 meters at a rate of 30 meters per minute, while the crab travels at the rate of 5 meters per minute. The auxiliary lifting gear raises a load of 45 tons, the greatest projection being 116 feet, at a rate of 20 feet per minute, and with a load of 150 tons on the large lifting gear, the greatest projection being 75 feet, the speed is 5 feet per minute. The track of the traveling gear is nearly 120 feet above the quay.

The derrick crane shown in Fig. 3 has a carrying capacity of 150 tons and is noted in the act of setting

FIR. 2.—150-TON HAMMER CRANE AT THE KRUPP WORKS, KIEL.

one of the large masts of the ship *Kaiser Karl der Grosse,* at Hamburg. This crane was erected at the wharf of Messrs. Blohm and Voss for serving ships lying alongside the quay or in the floating dock. It is operated by steam power. It is claimed by some prominent engineers to have several distinct advantages over the lately-introduced so-called hammer cranes with horizontal jib, and is said to be especially suitable for wharves where a full revolution of the crane of 360 degrees is not required or, in consequence of local conditions, impossible.

In the three-legged frame of this design very little room is taken up and the crane does not disturb or impede the traffic on the dock in the least. Even locomotive cranes with large jibs for auxiliary service may pass under the principal leg without difficulty. The principal advantage claimed for this crane, which in consequence of the non-existence of a counterweight is altogether much lighter, lies in the fact that it is provided with an adjustable jib, whereby the height of the ship to be served is of no consequence, as the masts can easily be avoided and any part of the ship between masts may be reached. The great height of the pulleys of 152 feet with the jib drawn in renders it possible to reach the highest parts of the ships, even if they lie in the dock. With a load of 150 tons, the greatest projection of jib being 66 feet, the rate of lifting is 4 feet 3 inches per minute, and with a load of 75 tons and the same projection of jib the speed is 8 feet 6 inches per minute. With the small hook and a load of 30 tons, the greatest projection being 10 feet 6 inches, the speed of 20 feet per minute is attained, while with a reduction of load to 10 tons the rates may be increased to 40 feet per minute.

This crane is operated by means of two double-cylinder steam engines, one of which drives the gear for lifting, while the other one transmits the power for slewing and altering the radius of the jib. The energy created by the slewing is mostly consumed by a friction clutch built into the shaft of the revolving gear, which excludes any compression on the frame or the driving gear.

Among the advantages of electric cranes may be mentioned the fact that the power supply is simply by means of a few thin wires, and the low weight of the electric motors and smallness of space occupied by them make them especially desirable. The last-mentioned qualities render it possible to employ three distinct motors corresponding to the three main movements of the crane, so that all the old complicated gearing, with its

frequent vexations, is entirely dispensed with. Raising and lowering is performed by one motor, a second one directs the swinging right and left, whilst a third motor has the function of moving the entire crane into a new position. It hence appears that the ideal electric crane is a three-motor crane.

This crane has the least complicated and the least power-consuming gearing, as is clear from the fact that each chief movement has its own motor. The latter is in each case in exact proportion to the work required of it, *i.e.*, a powerful one for raising, and again smaller motors for the other two movements. Each motor is only connected when working. No useless consumption of current is necessary. Hence the working is of the most economical nature possible, the more so as the size of each motor is in proportion to the work required of it. The greatest possible economy in the use of current may be reckoned as the first great advantage of the electric crane. Each of the movements, as we have seen, being independent of the others, two or three movements can be effected simultaneously, or even one by one. The possibility, however, to perform three distinct movements simultaneously renders it possible to carry the load on the shortest path from one spot to the other. Thus a further advantage of the three-motor crane is the quickest possible working, and, as time is money, the advantage gained will be of high value.

It is certain that the single-motor crane is a type that is more and more coming into disuse. Its first cost may be lower, but in use it will be found dear, inasmuch as it has the same complicated and power-consuming gearing as the steam crane. The one large motor has to be in constant service, only the couplings being from time to time hitched on or off as occasion requires. Even for such movements as require less power, such as turning from right to left, or moving backward and forward, the big motor has to be at work, so that the proportion of work done and of current consumption shows a remarkably low rate. The simultaneousness of movement and hence the ease and speed in starting are naturally less in the case of the one-motor crane; in short, this type is only a clumsy makeshift, and not a rational and well-thought-out machine, as is the case with the three-motor crane. The service rendered by a crane is of such an eminently high order that in many cases even four-motor cranes are constructed. These have two motors for hoisting, one for heavy, and a smaller one for lighter weights, which can be raised with greater speed. So that one and the same crane may, with the utmost economy, be adapted to the treatment of loads of varying weights.

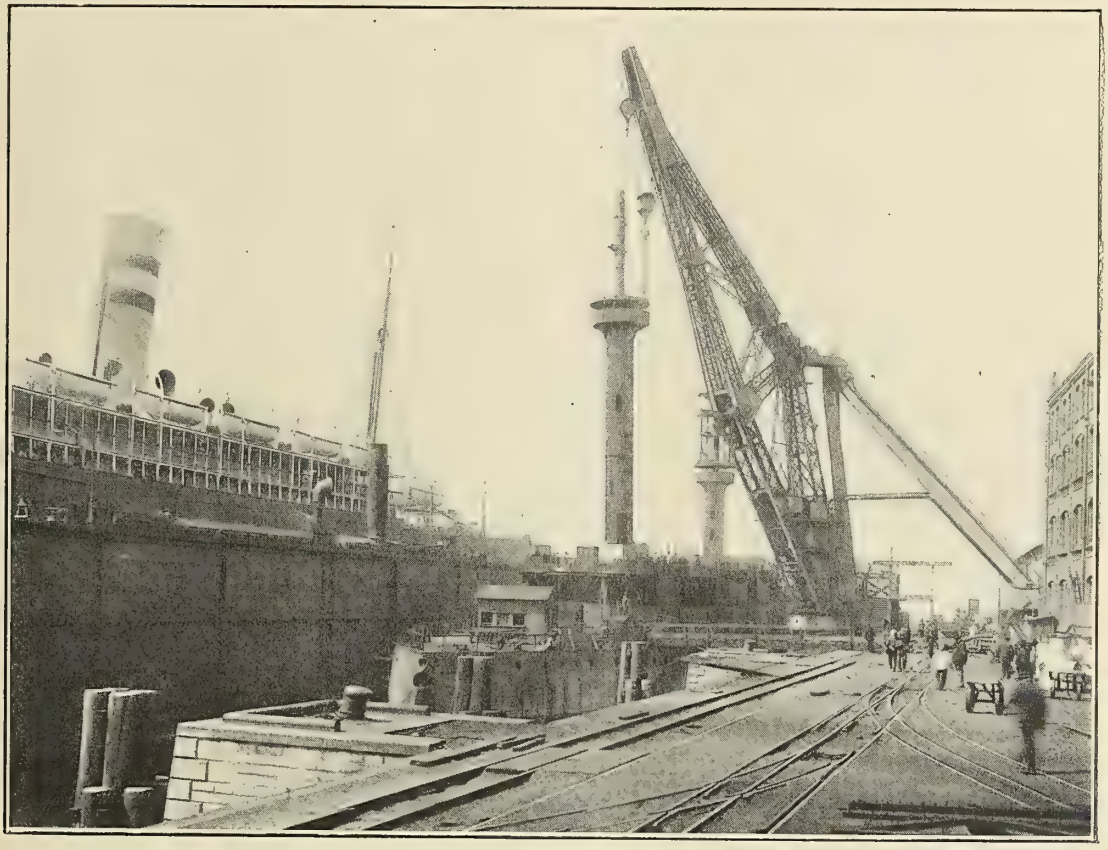


FIG. 3.—150-TON DERRICK CRANE, USED AT THE YARD OF BLOHM & VOSS.

In reference to traveling cranes, it may be said that it was due entirely in the first place to the application of electric current that they have become the high type of power-driven hoisting machinery they now are. Here again it is the three- or four-motor crane which takes the first rank, both with respect to economy in handling and to the rapidity with which the various movements are effected. Even the very smallest types may now be

driven by power. The difference between the past and the present in this particular is really quite amazing; in old days the cumbersome treatment by hand power requiring several men, and nowadays the rapid handling by means of electricity under the control of but one man.

Most engineers hold that, where at all feasible, it is always advisable to employ continuous current as a motive power for cranes. The continuous-current series motor, which quite spontaneously works more rapidly in the presence of lighter weights and more slowly in that of heavier ones, is in every respect the one best adapted for this kind of work. But it needs to be specially constructed—that is to say, specially designed—for the work required of it. Where, for instance, 20 horse power may be desired, it by no means suffices to put down any ordinary 20-horse-power motor. A rule-of-thumb manipulation of this character might easily result in the loss of current of 30 per cent. or more. In the first place the degree of magnetic saturation of the motor plays an important part in relation to the work required. It is hence essential that each motor be adapted to the special kind of work and stand in exact relation to the requirements and not merely figured for the maximum output. Besides continuous motors three-phase current motors may also be employed for cranes. Three-phase current motors labor under the disadvantage of running most rational when the speed is a uniform one. For economic reasons special figuring and adequate dimensions will be in this case even more necessary than in the case of continuous-current motors in order that they may well correspond to the varying speeds.

The three chief movements are effected either by means of three reversing regulators, or in the case of the cranes manufactured at Karlsruhe by the Gesellschaft für elektrische Industrie, a universal crane controller is employed, which permits to perform two movements of the crane with one single steering lever. The zero position of this lever is the horizontal one; when moved upward the load is raised; if turned to right or left the load follows the same direction; if turned in an upward direction and to the right the load follows a corresponding movement; if a circle be described by the lever the load performs a circular movement. This steering apparatus resembles an ordinary railway controller, only it is constructed with two cylinders, which, through the medium of cogwheels, may be turned by the lever either singly or both at the same time. The resistance is mounted separately in each case. In some special cases the universal steering apparatus is provided with a third cylinder for the third movement, which is set in motion by means of a separate small lever. But in a general way the use of a special reversing regulator quite suffices for the third movement. In this way the man in charge of the crane can, by the aid of his two hands alone, direct the three movements of the crane simultaneously. All the movements are thus centralized and are directed by one man. In the case of traveling cranes, and more particularly where very rapid running is required, the steering apparatus is kept in the bunk immediately below the crane-man. The elevated position of the man in charge affords him an extensive view around the whole field of operation, thus enabling him to work rapidly and with distinct aim. It goes without saying that good quality and durability of the steering apparatus on the one hand, and on the other hand its exact adaptation to the requirements of each individual case, are most important factors in the successful handling of cranes on a large scale. It is a necessary condition of rapid manipulation that the steering apparatus be graduated to a fine scale. Well-constructed cranes must deposit their loads upon the desired spots to within half an inch, straight away and without any prior bungling, uncertain attempts. In order to more fully insure this result the starting gear of all the cranes is provided with automatic electro-magnetic brakes. These brakes, as built at Karlsruhe, are lifted automatically the very moment the motors are connected, and begin to act at once as soon as the motors are disconnected. So long as the crane is idle all the brakes are in this way in full action; hence it follows that the arrest of movement is instantaneous. Furthermore, these brakes afford every guarantee in case of any hitch in the working. Should, for instance, the current from any cause suffer momentary interruption, the brake magnets would in that case become at once discharged of all current; they would immediately come into action and the counterweight hold the load fast where it was. For small cranes working at high speed, worm gearing is sometimes employed, the steel worms being cut out of the block, tempered, and ground; and milled worm wheels are often made of phosphor-bronze. Large cranes are sometimes fitted with rawhide gearing. All such parts as are brought frequently into operation are made of cast steel. The material used for raising and lowering weights varies according to the nature of the work. Either Gall's chains or steel ropes are employed. The hook of the crane runs in ball bearings, so that the chain or rope never gets twisted.

Feed Water, for Marine Water-Tube Boilers.

Water tube boilers require somewhat more care, both as to water tending and as to the character of the feed water, than do Scotch boilers. The care required to keep the proper water level will depend in a great measure on the area of the water line. With a relatively large area, sudden fluctuations are not as likely and the height of water can be more easily regulated. Nearly all express boilers and some of the large tube type are fitted with automatic feeding devices which in a great many cases are unsatisfactory. Whatever device is installed it should be so fitted that in case of breakdown it may be readily disconnected and the regulation done by hand.

With a battery of boilers, the general practice is to keep the feed pumps going continuously at a certain pressure by regulation at the pump, and then taking the water as needed at the boilers. In water tube boilers, especially those provided with feed heaters in the casing, the feed should be continual, and should never be entirely shut off as long as the boiler is furnishing steam. When the boiler is steaming and the feed shut off even for a short time there is the danger of some of the heating surface, especially in feed heater, becoming free of water and burning. A constant feed even of small volume will ensure all the proper parts being full of water.

FEED WATER.

The nature of the feed water should be most zealously watched, for it is the most important matter in connection with the proper working of the boilers. The feed should be clean, free from salt, oil, air, and should be as warm as possible.

Ordinary dirt can, of course, be kept out of the feed without any great difficulty. To prevent salt from entering is something much more difficult. In the first place there must be tight condensers and valves, to prevent any possibility of salt water mixing with the fresh, and to detect any leaks at the earliest possible time the water in the hot well must be frequently tested, so that measures to stop leakage may be immediately taken.

The pumps regularly used for pumping boilers should have no sea connections whatever, for it is by means of opening wrong valves and not properly washing out pumps after using them on bilge or sea, that salt finds its way to the boilers.

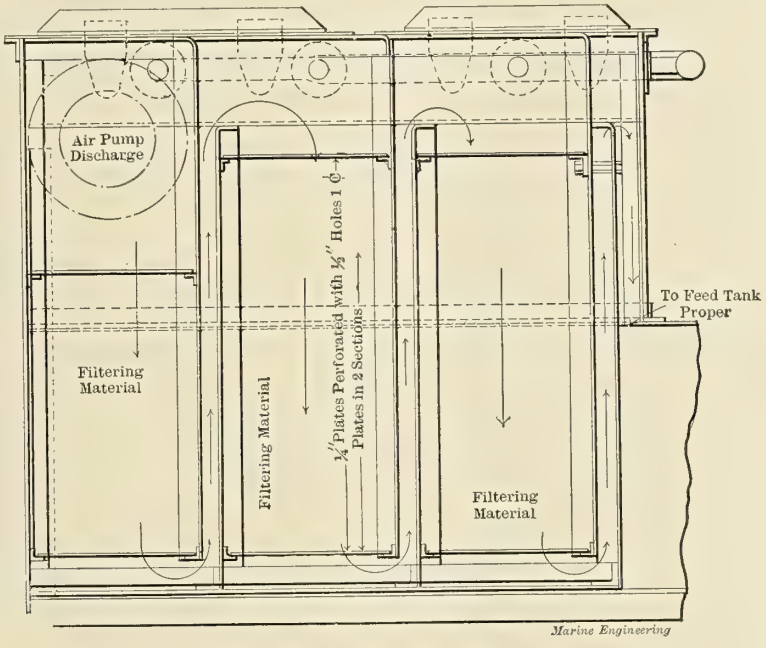
The best way to prevent oil from entering boiler is not to use any for internal lubrication, nor install auxiliaries having the forced feed lubrication enclosed type of engine. Even then oil will get into the exhaust from swabbing the piston rods and efficient grease extracters should be supplied and feed tanks provided with filter beds.

To keep air entirely out of the boilers is practically impossible, but its amount should be reduced to a minimum. This is done by, (1) keeping feed tank partly full at all times; (2) providing a float valve in feed tank which will close when water gets below a certain level; (3) having no leaks on suction side of pump by which air can be drawn in; (4) providing feed tanks with vapor pipes, thus facilitating the escape of air to the atmosphere; (5) keeping water in tank warm, since hot water does not contain near the amount of air that cold water does; (6) providing feed heaters with air cocks through which accumulated air may be blown out.

Air is one of the chief causes of corrosion in boilers; in combination with hard oil deposit it forms a crust on the heating surface making it rough, favorable to the collection of dirt and to corrosion; also the deposit diminishes the efficiency of the heating surface and the danger of burning the tubes.

NAVAL FILTER TANKS.

In naval practice the feed or hot well tanks are provided with a filter chamber located in the upper part of the hot well tank. A general type of which is herewith shown. The air pump discharge opens into tank at one end and the water flows through the filtering material as indicated by the arrows and then to feed tank proper.



NAVAL TYPE OF FEED-WATER FILTER.

Covers on top of the tank may be raised and then the perforated plates between which the filter bed is held removed, so that the whole tank can be easily cleaned.

The filtering material is of different kind; sponges soon rot and are expensive, excelsior and other material of a similar nature is sometimes used, but a very satisfactory material and one that can be readily obtained on board ship is coke. A handy arrangement is to place the coke in bags of convenient size made of coarse toweling or of a good grade of burlap. This allows the tank to be cleaned and the filtering material to be renewed with facility. Coke can be made in the fire room as it is needed and there is thus no need of stowage space for filtering material, which should be replaced at least once every three weeks and if considerable oil is used in engines, it should be done oftener.

Such an arrangement of filter can be easily installed on any vessel and if properly used will help out the efficiency of the boilers wonderfully. SUBSCRIBER.

Keys and Keyways in Shafting.

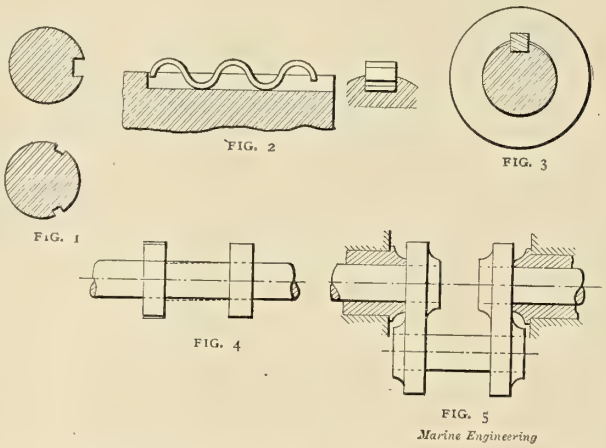
Where shafts are provided with independent couplings, either shrunk or forged on, they are generally held from turning in those couplings by either one or two keys. The key should be so proportioned that its shearing strength is slightly more than the twisting strength of the shaft. It must, therefore, have a width, which multiplied by its length will give the right sectional area in a plane tangent to the surface of the shaft as required by the strength of the shaft. Where only one key is used, it is poor practice to make it narrower than one-fourth of the diameter of the shaft, and the length should be proportioned to suit. On shafts of 8-inch diameter and above it is the practice to use two keys. Then the combined shearing strength of the two should be somewhat greater than the twisting strength of the shaft. Thus while the combined width of the keyways is no less than the width of the single keyway, the depth of the keyways is less, and therefore there is not so much metal cut out of the shaft for the two keyways as there is in the shaft with but one keyway, which means that the shaft with two keys is stronger. This is evident by reference to Fig. 1.

There is one difficulty against more than one key, which is the fitting of the keyways in the shaft and coupling, so that they will exactly correspond. If this is not the case, all the strain will be taken up by one key only, in which case the other key becomes useless. This is especially true where it is the practice to drive the keys when shrinking on the coupling, and before it is cooled off. In this case the keyways will have to be fitted very exactly, in order to come true. This, however, is a very poor practice, especially if the key should be made too full in depth, when it will prevent proper contact between the bored surface of the coupling, and the shaft, and will throw them slightly eccentric with each other.

A better method is to shrink the coupling on, using only a blind key, in order to get the keyways in line with each other. A blind key can best be made out of sheet metal, making the width to fit the keyway, and bending it as shown in Fig. 2. This strip of metal is laid into the keyway of the shaft, so that the corrugations project above the surface, and after the coupling is shrunk on, it can easily be drawn out. By using this method, the keyways can be finished after the shrinking process, and an even bearing may be secured for the key. This form is more expensive than the former method, as the keys and keyways will have to be fitted very exact, in order to get even contact, while the manufacturers who shrink their keys in, depend upon the elasticity of the metal to find its own seat. It would seem to some, that, when the hub of a coupling on the web of a crank is shrinking down to its original size, a key, which is too full, would hardly prevent it from doing so, as the amount of metal in the key is comparatively little if compared with the amount contained in the hub, and thus the key should in such a case be crushed. This, however, is not the case, as the crushing strain of a metal, which is prevented from spreading, by being held in a tight fitting and sufficiently strong enclosure, is almost unlimited. Besides this, the metal in the hub is not subjected to direct tension, in fact the stresses are partly bending stresses; also the metal, being heated, is in a more malleable state than that of the key.

The key can, however, prevent the proper contact, all around the joint, without being too full, as in a case where the corners of the key and keyways are slightly rounded, and such fillets are not fit properly; also if the key is made to fit very tight sideways it is liable to bend sufficiently on the sides of the keyway, to prevent the coupling from shrinking in its true cylindrical form. The result of any of the above faults are illustrated in an exaggerated condition in Fig. 3.

The writer has seen crank webs, on several built-up crank shafts where the keys which were driven while the webs were hot had worked loose; in all cases the condition of the joint indicated that there had been no contact for a large portion of the circumference of the



joint on either side of the key. In two cases, where two keys were used, the condition was so bad, that there was absolutely no contact between the keys, in fact the crank web bore only in three places, *i.e.*, on each key, and at a point half way between the keys and extending for about 1-16 of the circumference of the shaft on either side of this point. Of course, these are rare cases.

While some forms of hull construction offer a saving of weight over other forms and there are many ways where a good hull designer may cut down weights without materially weakening the structure, the machinery does not offer the same possibilities for reducing weight.

No accident has ever happened to an engine while it is on the drawing board, unless somebody should spill a bottle of ink over it; consequently the average designer will feel quite encouraged to "pintch" a little on the crank webs, for instance, in order to get a little more length added to his bearings, or worse still, to increase the length of the crank pins, so they will not run hot.

I can already see some of your readers smile about such ignorance as to oppose the increase of the length of a crank pin, but the writer has had some serious experiences with long crank pins on fore-and-aft compound engines.

In one case a builder had a contract for two 14 and 28 inches by 20 inch cross compound engines, left and right, for a twin screw steamer. The capacity of his shop as well as his finances were not any too great, and as he had plenty of time, he concluded to build one

engine at a time. The crank shaft of the first engine was a solid forging, and when the engine was started and tested, it worked beautifully. When the forging for the second shaft arrived, which was about two months after the other parts of the engine were finished, he found to his great dismay, that it contained a flaw, and therefore was useless. The time to deliver the second engine began to draw near, and the managers of the forging works could not promise a new shaft for some time, being overheaped with work. The engine builder thus decided to make a built-up shaft for the second engine, and when the engine was tried, it was found that the low pressure crank pin would run hot. As the shaft had been tested for alignment before being put in place, it appeared to be quite a puzzle, as the pin was actually flooded with oil.

Upon examination it was found that the low pressure pin would be canted as indicated by the dotted lines in Fig. 4, every time the high pressure was on the stroke and resulted in a perceptible twist on the low pressure connecting rod; by increasing the break load, even the crosshead pin began to warm up. When the crank brasses were dismounted it could plainly be seen where the pin bound, every time the crank pressed the center, and after removing the shaft, it could be seen that the pin had been working in the webs, and would have eventually worked loose altogether.

The writer then suggested that the crank webs be made as shown in Fig. 5, with increased thickness where the crank pins and journals were shrunk in; this could be done as the ends of the bearings were overhanging considerably. The new webs were fitted and when the engine was again tested, the crank pin behaved just as good as the one of the solid shaft.

There is also danger of the above kind, if the crank webs of a solid shaft are made too thin, as they are liable to twist then by the same action of the pin

When a crank pin is shrunk into the web, there is very little danger of its turning, as the friction of the brasses amounts to but very little as compared with the friction of a shrinking fit, consequently the expense of fitting a key may be avoided.

A very good method of keying a crank pin is to drill and tap the joint, which is very inexpensive, and will prevent the pin from turning or from working out.

This process is done by drilling a hole in the pin and web, so that one-half of the hole is in the pin and the other half in the web. Into this hole a standard bolt thread is tapped, and a tight fitting bolt screwed, which may then be cut off flush with the crank web. This method is adopted by many builders, but by using three such tapped keys, its security is greatly increased, especially if the bending action on the pin is very great. The three keys should be spaced at angles of 120 degrees and if the job is done properly, such a pin is almost equal to a pin forming a solid piece with the web.

H. E. R.

British Shallow Draft Gunboat.

There was recently tried an interesting shallow draft gun-boat, *H. M. S. Widgeon,* built by Yarrow & Company, Ltd., Poplar, to the order of Admiralty. The vessel has been designed specially for operations in shallow water and is fitted with a device, introduced by the builders, to enable high propulsive efficiency to be obtained with various conditions of draft. This arrangement, which has already been described in MARINE ENGINEERING,* consists in placing the propellers in longitudinal inverted troughs, the crest of which is above the water line, while the ends and sides are below the surface, even when the vessel is light. The propeller thus has a space to revolve in wholly above the line of the keel, which makes the arrangement specially suited for shallow draft navigation. When the screws revolve the air is driven out of the tunnel and the water, rising to fill the vacuum thus caused, keeps the screws fully immersed. It is evident that the rear slope of the tunnel down to the water line offers considerable resistance to the wake thrown from the propeller, and also that this slope is unnecessary when the vessel is loaded, as its only purpose is to maintain the vacuum by being immersed and so preventing air rising in the tunnel. In order to overcome this resistance when the vessel is deep laden, Messrs. Yarrow & Company have introduced a hinged flap, which forms the back part of the tunnel. At deep draft this is completely raised, and it is lowered as the vessel comes up in the water owing to consumption of fuel and stores or from any other cause. In this way an unobstructed flow to the propeller race is obtained, and yet a vacuum is secured in the tunnel at any draft.

The trials mentioned were designed more especially to test the efficiency of the device, and were carried out in the estuary of the Thames. They consisted first of a six hours' run at 11 knots, and a two hours' run at 13 knots. These two runs were made consecutively without a stop, the actual speeds being 11.030 knots and 13.058 knots respectively. The latter speed is remarkable, considering the draft was no more than 2 feet 8 inches. These runs were made with the flap up, the vessel being fully laden. An hour's run was then made with the flap down, the conditions in all other respects being as on the two hours' trial. The speed came out at 12.218 knots. It will, therefore, be seen that by means of the flap the speed of the vessel on full draft was raised more than four-fifths of a knot over what it would have been under the old conditions.

The *Widgeon* is 160 feet long and 24 feet 6 inches wide, the depth of hull being 6 feet. For facility of transport she has been constructed in sections not exceeding 18 feet in length fore and aft, each section being capable of floating by itself. These sections are so arranged, by means of deep floors or low bulkheads, that they can be bolted together in the water, and the complete vessel thus be built up afloat. The machinery space is protected by chrome steel armor of sufficient thickness to be bullet proof at a point-blank range of 20 yards. On the upper deck there is an armored battery 78 feet long, also protected by hard steel armor. Here are mounted two 6-pounder q. f. guns and four rifle calibre (.303) Maxim machine guns. There is also an armored conning tower forward.

The engines are of the compound condensing type, and the boilers are the Yarrow straight water-tube description. There are a steam windlass, with special warping arrangements for hauling up rapids, steam steering gear, and other auxiliaries.

*See MARINE ENGINEERING, October, 1902, page 506.

Fire and Loss of Life on the General Slocum.

On June 15, the excursion steamer *General Slocum,* well known in the waters of New York, took fire on the East river at a point about opposite 90th street, while going up the sound with an excursion from New York Sunday schools. The flames quickly spread over the entire vessel and fearful loss of life resulted. Most all of those on board were children and their mothers. The captain headed the ship for North Brother island, where she grounded and sank after all the upper works had been burned down. The loss of life has, at the time of writing, reaches nearly 900, and it is probable that there are 200 more victims of the accident.

The *Slocum* was built of wood throughout, but according to the rules of the United States Steamboat Inspection Service. She was 236.3 feet long, 38 feet molded breadth, 12.4 feet deep, and of 1,284 gross tons. She was driven by a single-cylinder walking-beam engine, the hull and machinery built in 1891. Above the main deck were two wooden decks from stem to stern. In the hold forward of the boilers was the lamp room, in which was stored the oils, paints, and other inflamable material, and it is in this room that the fire broke out. It is stated by one of the crew that a crate of glassware packed in straw was stowed in this room just before the fire was discovered. The deck hand notified the mate of the fire and one fire hose was coupled up and the pumps started. It is stated that the passengers in endeavoring to help with the hose kinked it in several places and that it broke before the water ever reached the nozzle. The flames gathered headway rapidly and swept aft with fearful speed, driving the passengers and crew either to the decks above or overboard. It was not long before the upper decks were ablaze forward, and fanned by the head wind the flames drove the helpless women and children to the rails or suffocated them. Such wild scenes of confusion, panic, and horror, related by the survivors, have never before been recorded. The life preservers, which were distributed to some extent by a few of the crew to the terrified passengers, in many cases proved to be death traps, as there was no buoyancy in them, and they carried the victims to the bottom.

Three investigations are at present underway, the one by the Steamboat Inspection Service is being personally conducted by Secretary Cortelyou of the Department of Commerce and Labor, and as evidence accumulates it looks at present writing as if the inspectors had not properly performed their duty, although a certificate of inspection was issued on May 7, 1904, allowing the *Slocum* to carry 2,500 passengers. The coroner of the Bronx, New York city, is bringing all the evidence that he can find before a coroner's jury composed of specially high-class men. The district attorney of the city is also accumulating evidence to see if there is a case of criminal negligence against the owners, the Knickerbocker Steamboat Company. This case, from the evidence to be brought out, it is to be hoped, will have most far-reaching results both in the improvement of the inspection service and the remodeling of the rules and regulations of that service.

THE EXCURSION STEAMER GENERAL SLOCUM, DESTROYED BY FIRE, AND BEACHED ON NORTH BROTHER ISLAND.

[Photograph by the New York Tribune.]

Report on Oil Fuel.—The so-called Liquid Fuel Board of the engineering corps of the navy, composed of Commander John R. Edwards and Lieutenant-Commanders W. M. Parks and F. H. Bailey, have submitted their report concerning the use of liquid fuel aboard ship. The report is based on extended experiments with different grades of oil, and different makes of burners, with natural and forced draft. The conclusions are that many of the supposed hindrances to the use of oil on shipboard have been done away with; that crude petroleum was found not to give as good results as after it had undergone a slight refinement; that the simplier the furnace the greater its efficiency; that forcing a boiler with oil fuel is much more readily accomplished than with coal. Concerning use on war ships, the board recommends that oil of a flash point not under 175 degrees F. should be used. This higher point required for naval vessels than for merchant ships is essential for the following reasons: War vessels must be kept in readiness to proceed to the tropics on immediate notice; the firing of guns subject naval ships to special dangers; because of numerous subdivisions on naval vessels it is extremely difficult to properly ventilate certain compartments; as a large number of men must be housed below decks it is difficult to prevent the use of open lights.

LAUNCHING THE UNITED STATES CRUISER CALIFORNIA.

BY E. P. LESLEY.

On April 28 the armored cruiser *California* was successfully launched from the ship yard of the Union Iron Works in San Francisco. The *California* is 502 feet long on the water line, 61 feet 6 1-2 inches beam, 24 feet draft, and 13,400 tons trial displacement. The required speed is 22 knots. The main battery consists of four 8-inch breech-loading rifles, mounted in two eliptical turrets, one forward and one aft, and a broadside battery of fourteen 6-inch breech-loading rifles, mounted behind 5-inch armor. The secondary battery is composed of eighteen 3-inch rapid-fire guns, twelve 3-pounder semi-automatic guns, four 1-pounder heavy automatic guns, four 1-pounder heavy rapid-fire guns, two 3-inch field pieces, six automatic guns, 0.30 caliber, two machine guns, 0.30 caliber, and two submerged torpedo tubes. The side armor is 6 inches thick amidships and tapered to 3 inches at the ends.

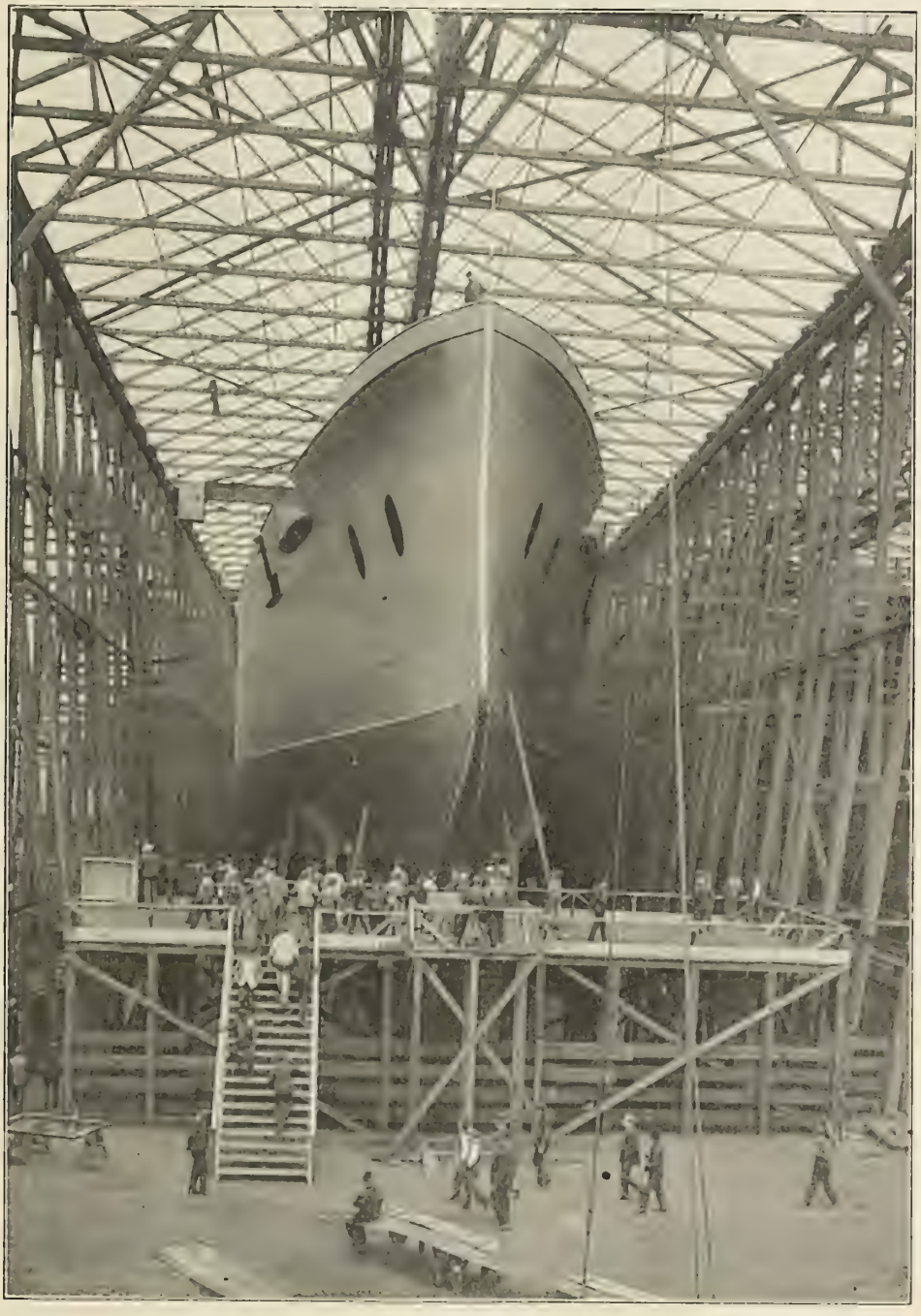


FIG. 1.—THE UNITED STATES ARMORED CRUISER CALIFORNIA, READY FOR LAUNCHING FROM THE YARD OF THE UNION IRON WORKS, SAN FRANCISCO, CAL.

A new device for releasing the ship was used at this

launch. An inclined track (Fig. 2) was built between the double ways on each side of the ship. At the bottom of this track stood the trip shore, *B*. This shore was knocked out by a blow from a 300-pound weight fixed to a carriage that was held at the top of the track by a trigger controlled from the launching platform. When released this carriage moved down the incline and the trip shore, which holds the dog shore in position, was knocked clear. Immediately the dog shore fell, and the ship was free to move. This device worked most successfully.

Some interesting data regarding launching velocity was obtained by use of a chronograph (Fig. 3) designed for this purpose by the writer. A fine steel wire, wound in one layer on the drum *A*, was attached to the ship. The drums *A* and *B* are so proportioned and geared together that a motion of the ship of one foot is shown by a motion of the surface of the drum *B* of 1-2 inch. A small carriage, *C*, carrying an electro magnet, is moved along the drum *B* by means of a screw shaft. A tracing point, hinged from this carriage, traces a line on a piece of paper wrapped around the drum. A metronone, gauged to beat 1-2 seconds, is used to make and break the circuit actuating the magnet. At each closing of the circuit the tracing point is drawn sharply to one side and thus a notched line is produced. The interval of time between two consecutive notches is 1-2 second and the distance between two consecutive notches is the travel of the ship for that half second, the scale being 1-2 inch to the foot. From the record thus produced, which covers the entire travel of the ship, curves of velocity, acceleration, and kinetic energy may be plotted, and from these the coefficient of friction may be determined.

The launching weight of the *California*, including the launching cradle, was 5,820 tons. The start was very slow, the ship moving but 9 inches in the first ten seconds. From this point the velocity rapidly increased, attaining a maximum of 22.1 feet per second at 41 seconds from the start and after a travel of 320 feet. The total distance traveled was 784 feet and the time from start to finish 76 seconds. The lubricant used was tallow 939 pounds, sterine 416 pounds, and soft soap 929 pounds. The coefficient of friction determined from the chronograph record of launching velocity was 0.0197.

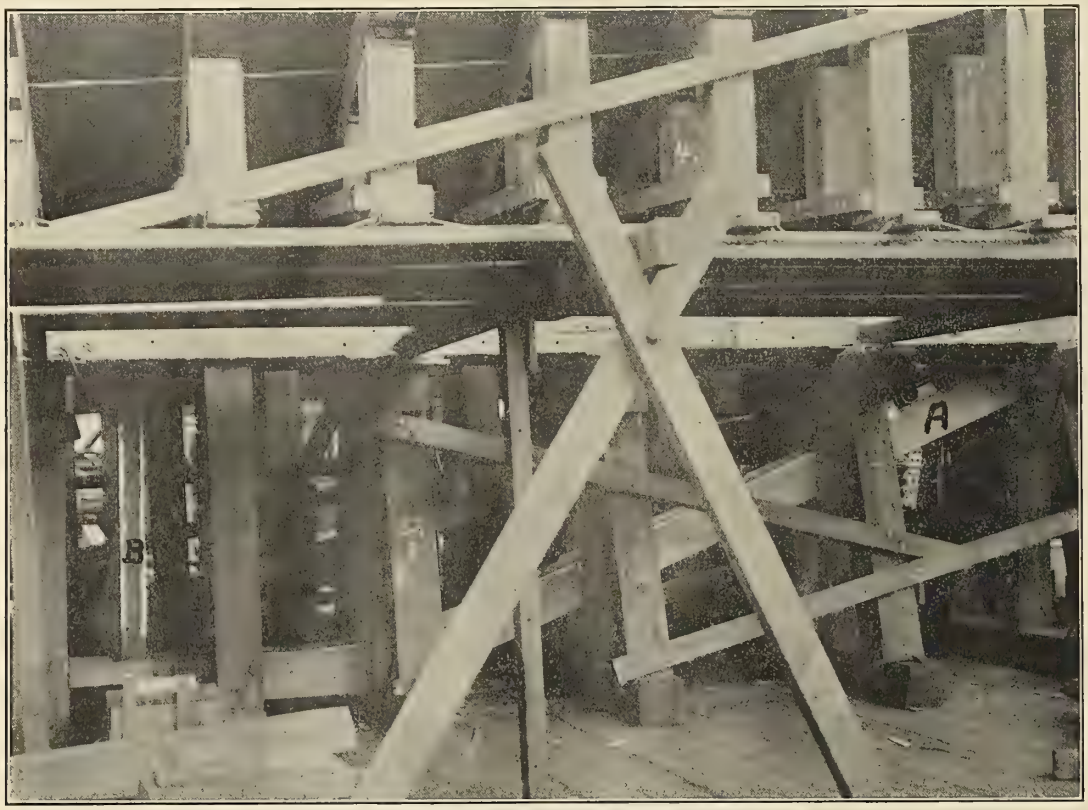


FIG. 2.—NEW RELEASING DEVICE USED IN THE LAUNCH OF THE CALIFORNIA.

Alcohol as a Motor Fuel.

House Bill 9302, introduced by Hon. Henry S. Boutell, of Illinois, in the last Congress, was intended to give the users of domestic alcohol for industrial purposes in this country the same exemption from internal revenue taxation that is granted in foreign countries The enactment of this bill would provide an abundant supply of a safe and economical motor fuel, at a price as low as, if not lower than, the cost of gasoline. The benefits which would result from such legislation are so manifest that the adoption of such a measure should be urged by every manufacturer or user of automobiles, power launches, or motor engines.

This measure has absolutely no connection with the question of the importation of foreign alcohol. It is not intended to interfere in any way with the present duty on imported alcohol. The material which it is pro-

posed to free from the present excessive internal revenue tax is alcohol made in this country from materials grown by our farmers, which has been rendered unfit for use as a beverage. The movement is therefore in no sense partisan or political. The chief obstacle to the enactment of this bill is the opposition of the wood alcohol interests, who are now enabled to sell their inferior product at a large profit by reason of the fact that it is not taxed.

In view of the hoped for legislation, it is well to call attention to properties of alcohol which make it such a decidedly satisfactory substitute for gasoline as a motor fuel, and its superiority in many important particulars.

It is clean, odorless and free from danger of accidental explosion. The vapor given off is not inflammable unless closely confined, and naked lights can be used around the machine with impunity. The worst danger to be apprehended from a leak in the pipe or storage tank would be the loss of the fuel, or a slow fire if a flame came into actual contact with the alcohol.

The supply is absolutely unlimited. Alcohol can be obtained from all substances containing sugar or starch, or compounds which can be transformed into sugar, such as corn, grains of all kinds, potatoes, cane and beet sugar refuse, grape skins and refuse of wine making, etc., etc. Increased demand can only have the effect of increasing production, and stimulating efforts to perfect and cheapen processes of distillation and distribution.

In countries where it is not made artificially dear by taxation, alcohol is rapidly taking the place of gasoline and other petroleum distillates, as a fuel for explosive motors of all kinds. In all the leading European countries alcohol made undrinkable by officially prescribed processes of denaturization is tax free.

The use of alcohol as a fuel is prevented in this country by an internal revenue tax equal to more than 1,000 per cent. of its cost. Under the present tax alcohol is fifteen times as costly as gasoline at its present price. If the tax on alcohol were removed it would be as cheap as gasoline, if not cheaper, and would be the best fuel for explosive engines.

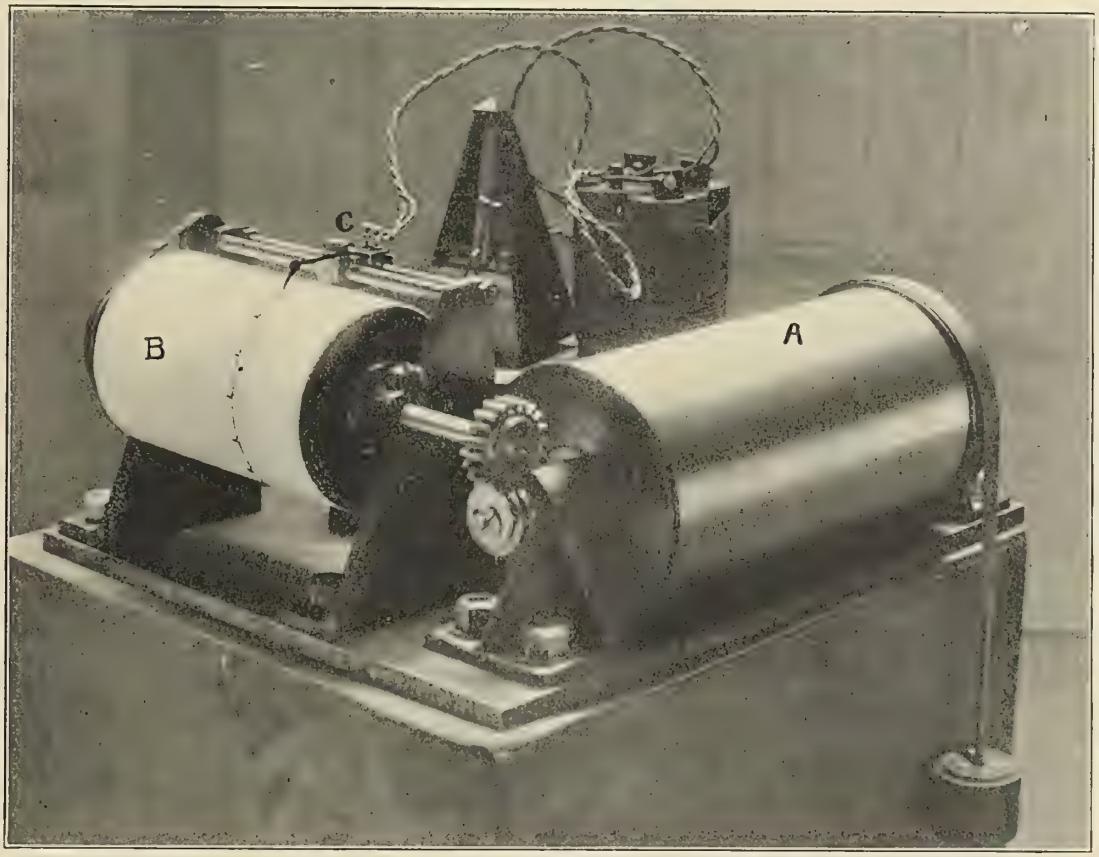


FIG. 3.—CHRONOGRAPH, FOR RECORDING THE VELOCITY OF THE SHIP AT DIFFERENT PERIODS OF THE LAUNCH.

Alcohol is being used very extensively in both France and Germany as a motor fuel. It is stated that although alcohol has a lower thermal value than gasoline, yet it has been demonstrated that its proportion of convertible heat units into work, to the total heat supplied (efficiency) is greater than gasoline. The explanation for this unusual statement is that the conditions in a combustion chamber of an explosive engine are such that only a small percentage of the heat energy of a rich fuel is utilized, whereas the conditions are highly favorable for the transformation of a larger percentage of the heat units of a fuel such as alcohol, and especially so when it is hydrated, *i. e.*, mixed with water,

TRIAL OF THE UNITED STATES REVENUE CUTTER MOHAWK.

The new revenue cutter *Mohawk* has, after many delays in her construction, been finally completed, and on February 6, 1904, was given her official trial trip in Chesapeake bay. The contract for the construction of this vessel was awarded to the William R. Trigg Company, of Richmond, Va., at its bid of $217,000, on April 20, 1900. She was to have been completed within twenty months from the date of the contract, but the financial embarrassment of the builders and the subsequent legal entanglements have delayed the finishing of the new cutter until the present time.

The new vessel is, in general appearance and dimensions, almost a duplicate of the *Onondaga* and *Algonquin*. Her rig is that of a two-masted schooner, and she will carry only sufficient fore-and-aft sails to steady her in a beam wind, or to heave to in a gale. The stem is ram-shaped, and throughout her construction is such that she may easily be transformed into a fast and serviceable gunboat in time of war, as she can carry six 4-inch breech-loading rifles and the usual secondary battery for vessels of her class.

The framing and plating is of mild open-hearth steel, the physical requirements of which were a tensile strength of not less than 55,000 pounds per square inch, and an elongation of 25 per cent. in 8 inches. The transverse frames, except at the extremities of the vessel, are of Z-bars, 5 by 3 by 3 inches by 12 pounds per linear foot, and spaced 24 inches between centers. The stem, stern post, and rudder frame are of the best hammered wrought iron. The main-deck beams are formed of angle bars, 6 by 3 inches by 12 1-3 pounds per foot, with a camber of 7 inches in 32 feet. There are accommodations provided for a crew of 60 men and 8 officers. The principal dimensions of the hull will be found in the data card, page 322.

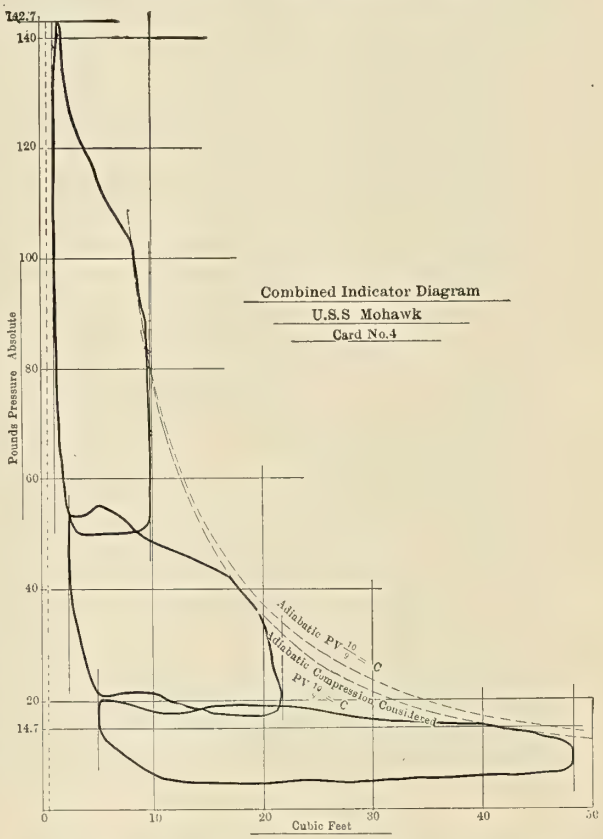
MACHINERY.

There is one vertical, inverted, direct-acting, triple-expansion engine with cylinders 25, 37 1-2, and 56 1-4 inches in diameter, respectively, having a common stroke of 30 inches. Each cylinder is fitted with hard, close-grained, cast-iron liner, and the I. P. and L. P. cylinders are steam jacketed. The valve gear is of the Stephenson link type, working a piston valve for the H. P. cylinder, and double-ported slide valves for the I. P. and L. P. cylinders. The I. P. and L. P. valves are assisted by counter-balance cylinders which are piped directly to the main condenser. The cut-off for each valve is adjustable by means of slotted reversing arms.

The main pistons are of cast steel, conical, and each is fitted with two hard cast iron packing rings 5-8 inch wide by 3-4 inch thick. The high- and intermediate-pressure packing rings are each made in six, and the low-pressure rings in eight sections, the joints between all sections being made with brass tongue pieces. Each cylinder is supported at the front by a forged steel column 6 inches in diameter. At the back they are supported by short cast iron columns which are bolted at the bottom to facings cast on the main condenser. Hollow guides for water circulation are bolted to the back columns. The bed plate is of cast iron in one piece. The top of the engine foundation is formed of one steel plate 3-4 inch thick, which is also extended aft, and forms the top of thrust bearing foundation.

The main condenser is in three sections bolted together, and forms a part of the framing of the main engine. Openings are provided for the main and auxiliary exhaust pipes, supplementary feed, evaporator discharge, soda tank, air pump suction, and boiling-out nozzle.

The reversing gear is of the ordinary direct-acting type, consisting of a steam cylinder bolted to the bed plate at the front and connecting to double arms on the reverse shaft. There is a hand-turning gear operated by a ratchet lever in conjunction with a worm and wheel secured to the shaft aft of the thrust bearing.



COMBINED INDICATOR DIAGRAM, TAKEN ON REVENUE CUTTER MOHAWK.

On page 322 will be found the data for the principal dimensions of machinery, and below are given further particulars of main engine and condenser:

Diameter of H. P. valve, 16 inches.

Dimensions of I. P. slide valve, 2 feet 11 11-64 inches by 3 feet 1-2 inch.

Dimensions of L. P. slide valve, 3 feet 4 5-8 inches by 4 feet 8 inches.

Area H. P. steam ports, maximum opening, top, 59.96; bottom, 64.12.

Area I. P. steam ports, maximum opening, top, 101.0; bottom, 108.0.

Area L. P. steam ports, maximum opening, top, 202.0; bottom, 220.93.

Main steam pipe, diameter, 9 inches.

Exhaust pipe, I. P. to L. P. cylinder, diameter, 14 1-2 inches.

Exhaust pipe, L. P. cylinder to condenser, diameter, 19 inches.

Ratio of net area of H. P. to I. P. piston, 1 : 2.26.

Ratio of net area of I. P. to L. P. piston, 1 : 2.25.

Ratio of net area of H. P. to L. P. piston, 1 : 5.06.

Main condenser, length over all, 16 feet 5 1-4 inches.

Width, inside, 2 feet 1-2 inch.

Length of tubes, 14 feet 5 inches.

Number of tubes, 1,217.

Diameter of tubes (outside), 5-8 inch.

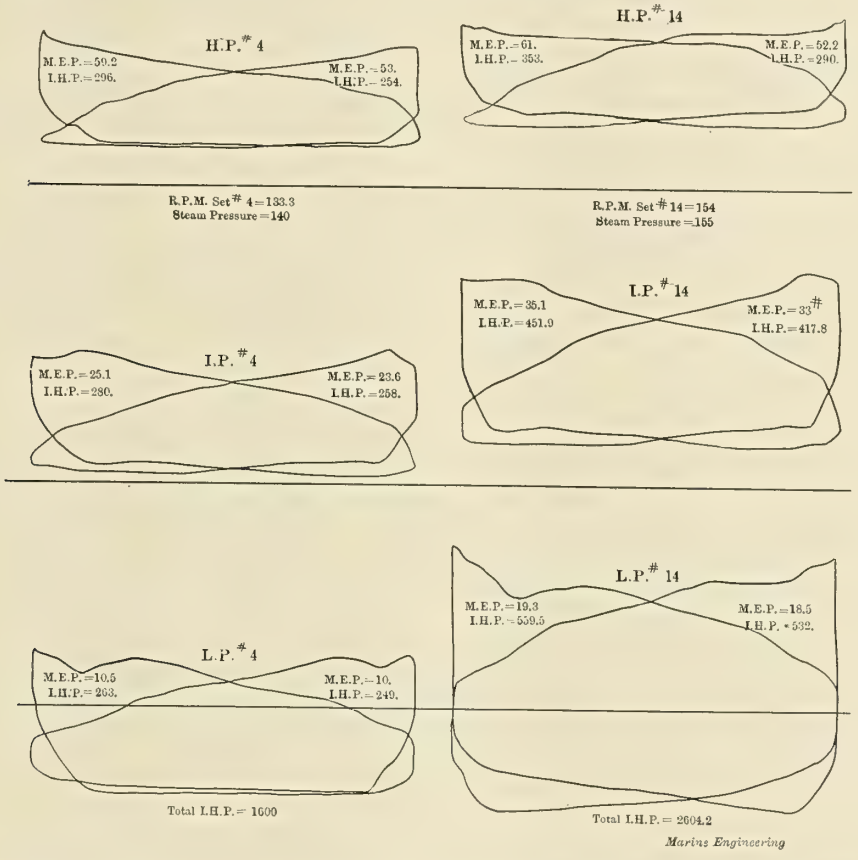
Cooling surface, 2,870 square feet.

system, having two direct-acting steam cylinders, each 9 inches in diameter, and two air cylinders, each 20 inches in diameter, the common stroke being 12 inches.

One independent centrifugal circulating pump operated by a steam engine having a cylinder 8 inches in diameter by 8 inches stroke, the diameter of the suction and discharge nozzles of the pump being each 10 inches.

One vertical duplex main feed pump, having 8 inches diameter of steam cylinders, 5 inches diameter of water cylinders, and 12 inches stroke, located in the engine room.

One auxiliary feed pump of the same pattern and dimensions as the main feed pump, and also located in the engine room.



SET OF CARDS AT NATURAL AND FORCED DRAFT, TAKEN ON THE TRIAL OF THE UNITED STATES REVENUE CUTTER MOHAWK.

There are four single-end Scotch boilers, arranged in pairs in one water-tight compartment, with a single athwarship fire room between them. Forced draft of the closed fire room system is provided. The shell of each boiler is composed of only two plates. The longitudinal seams are double butt-strapped and treble riveted, while the two end circumferential seams are lapped and double riveted. Each boiler has two Fox's corrugated steel furnaces; the tubes are of seamless drawn steel. The dimensions will be found on the data card.

AUXILIARIES.

The new vessel is fitted with a very complete system of auxiliaries, which consist essentially of the following:

One independent air pump of the vertical twin-pump

Two boiler feed injectors with flanged connections, of the Metropolitan type, No. 14 1-2.

One horizontal bilge pump, having a steam cylinder 6 inches in diameter, a water cylinder 8 inches in diameter, and a stroke of 10 inches.

One vertical duplex fire pump, which is also used to operate the ash ejector, and as an emergency circulating pump, having steam cylinders 14 inches diameter, water cylinders 8 1-2 inches, and a stroke of 12 inches.

One general service pump of the vertical duplex type, having steam cylinders 7 1-2 inches in diameter, water cylinders 5 inches diameter, and 8 inches stroke. This pump can be used for fire, washing down decks, circulating water through distiller, and for bilge purposes when necessary.

One combined fresh- and salt-water pump for the distilling appartus, having a steam cylinder 3 1-2 inches in diameter, a fresh-water cylinder 2 1-8 inches in diameter, a salt-water cylinder 2 1-8 inches in diameter, and a stroke of 4 inches.

One combined feed-water heater and auxiliary condenser, having 240 square feet of tube surface. This apparatus, when used as an auxiliary condenser, is operated by a combined pump, having a steam cylinder 6 inches in diameter, an air cylinder 6 inches in diameter, a circulating cylinder 6 inches in diameter, and a stroke of 6 inches.

In connection with the sanitary system of the vessel there is a flushing pump for closets, having a steam cylinder 4 1-2 inches in diameter, a water cylinder 4 3-4 inches in diameter, and a stroke of 6 inches. There is also an air-compressing pump which forces air into a cylindrical fresh-water tank for supplying wash basins and bath tubs. This pump has a steam cylinder 4 1-2 inches in diameter, an air cylinder 5 1-2 inches in diameter, and a stroke of 4 1-2 inches.

The forced-draft system is operated by two fans, 50 inches in diameter, each fan being run by a pair of steam cylinders 5 inches in diameter by 5 inches stroke.

The steam-steering gear is operated by two steam cylinders, each 4 1-2 inches diameter by 4 1-2 inches stroke.

There is a steam engine 4 inches diameter by 4 inches stroke for operating the machine-shop tools, such as lathe, drill press, emery grinder, etc.

The windlass engine has two steam cylinders, each 7 inches in diameter by 8 inches stroke.

There will also be a 10-Kw. dynamo driven by a 7 by 7-inch engine.

To show to what an extent the use of auxiliaries has reached in a modern steam vessel, it may be interesting to note that the combined volumes of the steam cylinders of all auxiliaries on this vessel amount to 70 per cent. of the volume of the high-pressure cylinder of the main engine.

TRIAL TRIP.

The under-way trial took place in the lower part of Chesapeake bay and Hampton roads on February 6, 1904, and consisted of a total run of eight hours at varying speeds and under varying conditions, such as the vessel is expected to encounter under service conditions. On the first four hours of the trial, under natural draft, using all four boilers, an average speed was developed of 14.92 knots, which was determined by observations in passing between light houses and measuring the distances from charts. Runs in both directions were made in order to neutralize, so far as possible, the tidal influences. The following are the approximate results obtained as an average of the performance of the main engine during the natural-draft trial:

I. H. P. main engine	1601.4
Revolutions	133.3
Steam pressure (at engine)	145 lbs.
Vacuum	25.5 inches
First receiver	41 pounds
Second receiver	5 1-2 pounds
Strokes of air pump	65
Revolutions of circulating pump	268
Strokes of feed pump	20
Temperature of sea water	50 degrees
Temperature of discharge water	74 degrees
Temperature of hot well	89 degrees
Temperature of feed water	166 degrees

During the latter part of the forced-draft trial, an opportunity was offered of testing the speed under maximum conditions in comparatively deep water, between Old Point Comfort and Thimble Shoal light. The distance is 3.3 nautical miles, and two runs were made over the course in each direction, without slowing the engine at the turns, at an average speed of 16.82 knots. Shortly before these trials were begun one of the blowers became disabled, so that it was impossible to carry an air pressure of more than 1-4 inch in the fire room, whereas 3-4 inch had been maintained during the earlier part of the trial. The fires were also quite dirty; with an air pressure of 3-4 inch and clean fires the vessel could undoubtedly make a maximum speed of 18 knots per hour. The following data were recorded as a result of the maximum run under forced draft, the by-passes being opened to the first and second receivers at the time the cards were taken:

I. H. P. (main engine only)	2,604
I. H. P. all auxiliaries (estimated)	156
I. H. P., total for main engine and auxiliaries	2,760
Revolutions	154

MARINE ENGINEERING DATA CARD. JULY, 1904.

NAME—Mohawk. NATIONALITY—American. TYPE—Revenue cutter.
LAUNCHED—1902 BUILDERS—Wm. R. Trigg Co. OWNERS—U. S. Treasury Department.

Length over all	205 ft. 6 ins.
" between perps	188 " 0 "
Breadth, molded	32 " 0 "
Depth, "	17 " 0 "
Draft, mean, normal	11 " 0 "
Displacement, corresponding	985 tons
Area immersed midship section	299 sq. ft.
Wetted surface	6,722 " "
Block coefficient	.486
Midship section coefficient	.799
Engines: Type	3 cylinder triple
Cylinder diameters	25, 37 1-2 and 56 1-4 ins.
Stroke	30 "
Valves, piston on H. P., slide on I. P. and L. P.	
Columns, front, forged steel, back cast iron	
Piston rods, diameter	5 ins.
Connecting rods, diameter,	
top 5 ins., bottom 6 1-2 ins.	
" length bet. centers, 6 ft. 3 "	
Crossheads, ahead surface	208 sq. "
" pins, 5 3-4 ins dia. by 6 1-4 ins. long	
Crank pins, 10 1-2 ins. dia. by 13 1-2 ins. long	
Shaft, crank, and propeller, diam., 10 1-2 ins.	
" thrust and line, " 9 3-4 "	
Thrust surface (9 collars)	575 sq. ins.
Air pump	independent twin vertical
Condenser, cooling surface	2,870 sq. ft.
Boilers	4 Scotch
Steam pressure	160 lbs.
Length over all	10 ft. 1 ins.
Diameter, outside	11 " 8 "
Thickness of shell	1 1-8 "
Furnaces	2 each, 44 ins. diam. inside
Length of grate	6 ft.
Tubes, outside diam	2 3-4 ins.
Number 58 stay, 164 ordinary,	
Length between sheets	6 ft 11 1-2 "
Height of stack above grates	54 ft. 6 "
Draft, forced closed stoke hold.	
H. S. one boiler	1 357 sq. ft.
G. S. "	43.8 " "
Area through tubes, calorimeter	6.04 " "
" of smoke stack	30 6 " "
H. S. ÷ G. S.	31
G. S. ÷ Calorimeter	7.24
Propeller:	
Diameter	10 ft. 9 ins.
Pitch (true)	13 " 6 "
Area (helicoidal)	40.43 sq. ft.
Material	cast steel
Number of blades	4

Slip, actual, mean of four runs	17.5 per cent.
Steam pressure	160 pounds
Vacuum	27 inches
First receiver	62 pounds
Second receiver	15 pounds
Strokes of air pumps	58
Revolutions of circulating pump	270
Strokes, feed pump	33
Temperature, sea water	50 degrees
Temperature, discharge water	86 degrees
Temperature, feed water	185 degrees

The steam machinery of the *Mohawk* was designed and superintended by Captain John W. Collins, the engineer-in-chief of the revenue cutter service, and it represents in its entirety as complete and efficient an installation of marine devices as was ever put in a vessel of this size and class.

and poop decks are covered by boat decks extending out to the ship's side, thus providing sheltered promenades for both first and third class passengers. A somewhat novel feature in the vessel is the special stowage arranged for yeast, a perishable cargo, of which considerable quantities are carried by this route.

The decorative features of the public apartments have been very carefully designed and executed. The first-class deck saloon is framed in oak, the panels, frieze, and dado being richly figured teak, giving a most effective contrast. The apartment is lighted overhead by fine skylight with richly colored stained glass, while round the air trunk there is a series of borrowed lights in lead work and art glass. The upholstery is in crimson buffalo hide. The windows are draped with gold tapestry curtains, while the floor is covered with Wilton carpet and runners. The dining saloon is framed

THE LATEST TURBINE STEAMER, PRINCESS MAUD, BUILT FOR THE IRISH CHANNEL ROUTE.

New Turbine Steamer Princess Maud.

The steamer *Princess Maud,* which has just been launched at Dumbarton, by Wm. Denny & Brothers, for the Larne & Stranbaer Steamship Joint Committee, is the first turbine steamer to be placed on the Irish cross-channel service. Her principal dimensions are, length 300 feet, breadth 40 feet, depth 24 feet 8 inches to promenade deck.

The first-class accommodation, which is situated amidships, consists of a deck saloon, ladies' cabin, smoking room, and four special state-rooms on the promenade deck, a dining saloon and a number of special state-rooms on the main deck. The third-class accommodation aft consists of a ladies' cabin on the poop deck, a saloon on the lower deck, and a large restaurant on the main deck, alongside of which is accommodation for cattle dealers. The remaining spaces on the main and lower decks, together with the fore hold, are fitted up for the carriage of cattle and horses. Both the bridge and paneled in oak throughout, dim polished, enriched by judicious arrangement of carving. The architectural style is Renaissance in character. There are neat little sideboards at the fore end of the saloon flanking the mast casing, which are surmounted by beveled mirrors, a clock and barometer in carved cases being fitted above the mirrors. A similar sideboard is fitted in a recess at the after end of the saloon, balanced by a hot press, which externally is of cabinet work similar to the sideboards. The upholstery is in crimson buffalo hide and the windows are draped with tapestry curtains in blue and gold, the floor being covered with Brussels carpet and runners. Entrance to the saloon is obtained by two sets of swinging doors with fine leaded glass panels, into which are wrought the "bloody hand of Ulster." Above the centre of the saloon is a large well for light and air, finished in white and surmounted by a skylight having stained glass of appropriate design and coloring. The ladies' saloon on the

promenade deck is in ivory white with polished cedar dado; the upper part is an arch design with Greek ornament, freely treated. There are large, full height mirrors and leaded glass doors. The seats are upholstered in figured moquette of blue shades; the windows have gold tapestry curtains and the floor is laid with Wilton carpets and runners. The ladies' retiring room on the main deck is in polished sycamore, the panels being decorated in Japanese style with apple blossom and bird design. A well-fitted-up dressing table, with large mirror above, is fitted for the conveniece of the lady passengers and the apple blossom "motif" is repeated in the leaded glass door. This apartment is upholstered in blue, figured moquette. The smoking room is paneled throughout in dim polished oak, lightly relieved with carving. As in the other apartments, full advantage is made of the decorative effect produced by richly colored stained glass, both in the skylight and in the entrance doors. A special decorative feature of this apartment is a set of three large enameled tile panels, beautifully colored, representing marine subjects, conventionally treated. The seats are upholstered in crimson buffalo hide, and the usual smoking room requisites are fully supplied.

The vessel is fitted with a complete galley, pantry, etc., and the lavatory accommodation is thoroughly up-to-date, baths being provided for both ladies and gentlemen. The ship is lighted throughout by electric light, the installation being carried out by the builders themselves. The appliances for working the ship are of the most complete description, consisting of a powerful steam windlass and capstan on the forecastle, and a large warping capstan on the poop. To facilitate handling in harbors the vessel has rudders both aft and forward, the after rudder, which is of the balanced type, specially designed by the builders for their turbine steamers, is worked by Brown Brothers' steam tiller, controlled from the flying bridge by telemotor. The forward rudder is worked by a steam steering gear, also controlled from the flying bridge. The vessel has an equipment of boats and other life-saving appliances, fully up to Board of Trade standard, all the boats being fitted with rapidly clearing chocks and patent disengaging gear. The propelling machinery consists of three sets of turbines by Parsons Marine Steam Turbine Company, supplied with steam by boilers constructed by Messrs. Denny & Company, of Dumbarton. On official trial the guaranteed speed of 20 knots was exceeded, the mean speed of 20.7 knots being attained.

Turbines and the British Board of Trade Survey.

A decision relating to the construction of turbine steamers was lately issued by the Court of Survey in Glasgow on an appeal by William Denny & Brothers, the shipbuilders, of Dumbarton. The facts briefly set out are as follows: The *Princess Maud,* built by Denny & Brothers, is a turbine ship. The turbine engines are provided by Messrs. Parsons and built by them at their own works. What they built and supplied to Denny & Brothers stopped at the condensers; that is to say, the propelling power was provided by Messrs. Parsons from their own works, and no questions arose with regard to it. The turbines were delivered to Denny & Brothers, and had to be fitted to the vessel, and the minor parts of the machinery provided by Denny & Brothers and attached by themselves included the condensers required for the turbines. The question between the Board of Trade and Denny & Brothers had reference to the condensers and to their sufficiency for what was required of them.

The Messrs. Denny took up the position that the Board of Trade were not entitled nor justified in demanding a certain test before the condensers were passed with a view to the certificate which was necessary for a passenger vessel. The certificate is issued by the Board of Trade, but as a precedent there was required to be made a declaration by the shipwrights' surveyor and the engineers' surveyor who had the vessel under survey. The Board of Trade had given certain instructions to their surveyor with which he was required to comply, but the Messrs. Denny refused the necessary facilities, and the certificate accordingly was refused. The question which the Court had to try was whether headquarters had the right to give its surveyors such directions, and whether those were competent and reasonable. The question arose because they were dealing not with ordinary engines, but with turbine machinery, experience of which had not been yet sufficient to enable the Board of Trade to lay down the same simple series of regulations as with regard to the engines to which shipbuilders had been accustomed for many years.

The Court sustained the appeal, and pointed out that this test is a new departure in survey practice, and that, as the Board of Trade was the party proposing to depart from use and wont, it lay upon them to show that there were new circumstances justifying a new departure. Considerable importance attached to this point, as it was admitted that if the Board of Trade's action was approved, this requirement would become a precedent for turbine steamer surveys in future, and would place turbine steamers at a disadvantage compared with ordinary steamers. The Court, however, find that the test is unreasonable. They point out that, while the Board of Trade have a great duty to the traveling public, they also have a responsibility to the shipbuilding and allied industries, and must not in their zeal for the public safety unnecessarily impose restrictions on an industry, and especially an industry in its development stage.—*Iron Age.*

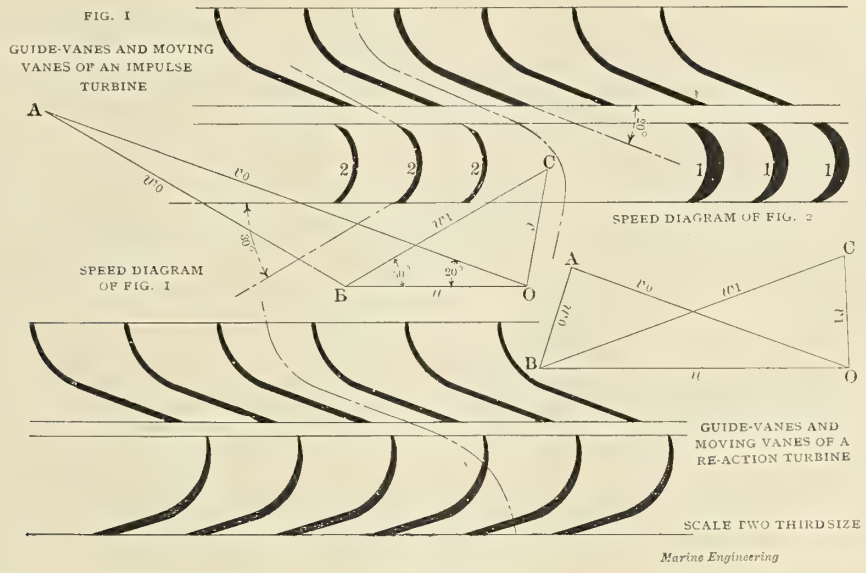
One Shipyard to Continue.—Creditors of the Townsend-Downey Shipbuilding Company, at a recent meeting, unanimously adopted a resolution requesting receiver Henry S. Ide to obtain authority to continue the business for an additional eight months from the time of expiration of the present extension on July 1. The opportunities for bidding on new work and for carrying out repair work are so favorable that the creditors made this request.

DIFFERENT APPLICATIONS OF STEAM TURBINES.*

BY PROFESSOR A. RATEAU, OF PARIS.

One of the most interesting developments in mechanical engineering during the years 1902 and 1903, was the greatly extended use of steam turbines. This development is the result of efforts which have been made by various people to increase the efficiency of turbines to such a point that they may compete commercially with reciprocating engines. The author has been occupied for more than fifteen years in the study of rotary engines, and he has already published several papers upon the subject. He believes that in presenting to the Institution of Mechanical Engineers an account of the practical result of his labors upon steam turbines he will contribute usefully to the study of this important question.

Although the principles which distinguish the different kinds of turbines are well known, it may be useful to recall briefly their distinctive characters in order that his own type of turbine may be more easily distinguished. In common with all other steam engines, turbines transform into mechanical work the energy given out by steam during its expansion from the initial pressure of admission to the pressure at the exhaust. But whilst reciprocating engines effect this transformation of energy by means of variation in pressure of the steam, turbines can effect this transformation both by means of the pressure and by means of the velocity of the steam while expanding. The employment of the velocity only in each moving wheel characterizes the action or impulsion turbines, among which may be cited the Laval and Curtis turbines, as well as that designed by the author; whilst the simultaneous employment of the velocity, and partial use of the pressure characterize the re-action turbine, of which the best-known type is that of Parsons. Whatever may be the method in which the steam acts in the turbine, the chief problem consists in the employment, with good conditions of efficiency, of the very great velocities attained by the steam in expanding. When the expansion takes place in one stage, as in turbines with a single wheel, then the velocity of flow reaches, as is well known in a condensing engine, a value which is usually above 3,600 feet per second. But in order to obtain the maximum efficiency, the moving part of the machine should have a relative velocity which is approximately the half of that of the steam. As it is practically impossible to construct turbine wheels suitable for running with a peripheral velocity above 1,200 feet per second, the efficiency of turbines with a single wheel is necessarily low, this being due chiefly to the necessity for the employment of diverging inlet nozzles which give rise to great losses of energy by friction and eddying. On the other hand, angular velocities which correspond to these peripheral speeds prevent the direct driving of dynamos, and render necessary reduction gears of special and costly construction, which, however, cannot be protected from excessive wear, and are exposed to accidental breakage.



FIGS. 1 AND 2.

A consideration of these circumstances has induced inventors to divide the expansion of the steam into successive stages, and thus to produce turbines with multiple wheels, which are nothing but a series of simple turbines mounted upon the same shaft and driven successively by the same current of steam. This design of multiple turbines is by no means novel. It will suffice to mention the name of Tournaire, a French mining engineer, whose theoretical description to the Academy of Science in 1853 of a re-action turbine with multiple wheels is surprising, when the description is compared with the Parsons turbine brought into use 30 years later.

Every simple turbine may be designed either as an impulse turbine or as a re-action turbine. In the former kind the fall of pressure under which the simple turbine works takes place solely in the distributor, whilst

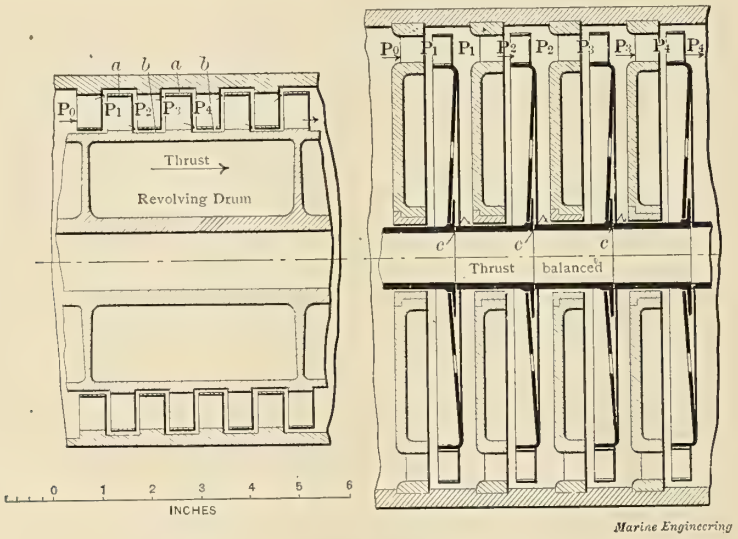
*Paper read at the Chicago meeting, June, 1904, of the Institution of Mechanical Engineers of England.

in the latter type the fall of pressure takes place, not only in the distributor, but also in the moving wheel, so that in the latter type there is a higher pressure in the guide vanes than at the exit. Fig. 1 represents the guide vanes and the moving vanes of an impulse turbine, in which it is supposed that the fall of pressure is small enough at the vanes to render unnecessary the use of diverging nozzles, as in the Laval turbine. In the illustration the triangles of velocities are given at the entrance *OAB*, and at the exit *OBC* of the moving wheel. Similarly in Fig. 2 are shown the guide vanes and the moving vanes of a re-action turbine, and the triangles of velocities at the entrance *OAB* and at the exit *OBC* of the moving wheel are shown in the figure. It is obvious from these illustrations that, by the mere inspection of the moving vanes, it is possible to distinguish between an action turbine and a re-action turbine. In the former type the vanes appear in transverse section in the form of an arc of a circle with entrance and outlet angles practically the same, whilst in the re-action turbine the cross section of the vanes is in the form of a parabolic arc, the entrance angle being more or less approximately 90 degrees, whilst the outlet angle is generally between 20 degrees and 30 degrees. Generally the vanes are increased in thickness in the middle, so that the steam spaces between them have approximately a constant transverse section for impulse turbines or decreasing section for re-action turbines. If, however, they are made of plate they may have a constant thickness, as in *2*, Fig. 1. In re-action turbines it is important that the increase in thickness should be suitably calculated, otherwise there will be an important loss of efficiency. It is otherwise with the impulse turbine, in which the efficiency is very little affected whether the vanes have a constant or variable thickness. In a given turbine with multiple wheels the different simple turbines may be all designed in the same way or some may be designed in one way and some in another way to produce a hybrid system.

Drum Turbines and Multicellular Turbines.—From another point of view, drum turbines may be distinguished from multicellular turbines; in the former type, of which the Parsons turbine is the best-known example, the moving vanes are fixed upon the periphery of a cylindrical drum; in the latter they are fixed to the periphery of wheels more or less flat and separated from each other by diaphragms which divide the interior of the turbine into cells. The turbine of the author belongs to the latter type.

Fig. 3 is a diagram of a drum turbine, and Fig. 4 a diagram of a multicellular turbine. These two types have different properties, so far as losses of steam are concerned. In the multicellular action turbine leakage of steam can only take place through the play *c*, Fig. 4, which exists between the shaft and the ring of the fixed diaphragm which surrounds this shaft. In the re-action drum turbine, on the contrary, leakage may take place: first, around the moving wheels in *a*, Fig. 3 (by reason of the re-action); and second, in *b*, through the play between the guide vanes and the moving drum. The first leakage can be suppressed, if desired, by making the wheels work by impulsion instead of by re-action, but then the second leakage between the fixed vanes and the moving wheel attains its maximum. It is because of this leakage at the periphery of the drum that turbines of the Parsons type require the most accurate workmanship. It is easy to understand that a play of some tenths of a millimeter is sufficient, at least upon the high-pressure side, to produce a cross-sectional area of the leakage passages equal to that of the admission passages between the distributing vanes; if by specially exact workmanship the cross section of the leakage passages is made very small, is it not to be feared that, after some years of use, the wear of the parts, either by friction of the moving parts against the fixed parts or by the action of the steam, will increase the cross section of the leakage passages, and so cause a notable decrease in the efficiency of the machine?

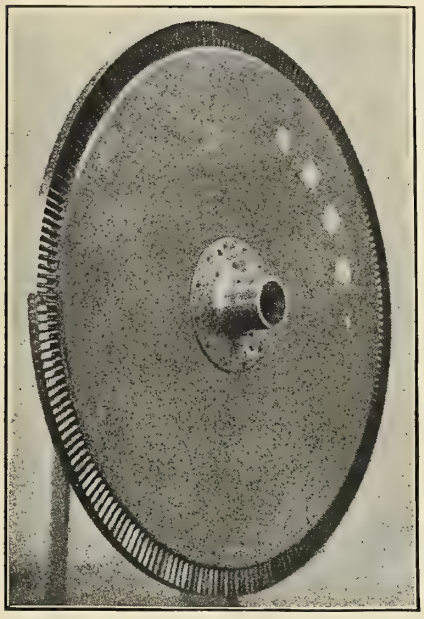
In multicellular turbines the leakage, being confined to the periphery of the shaft, is reduced in proportion to

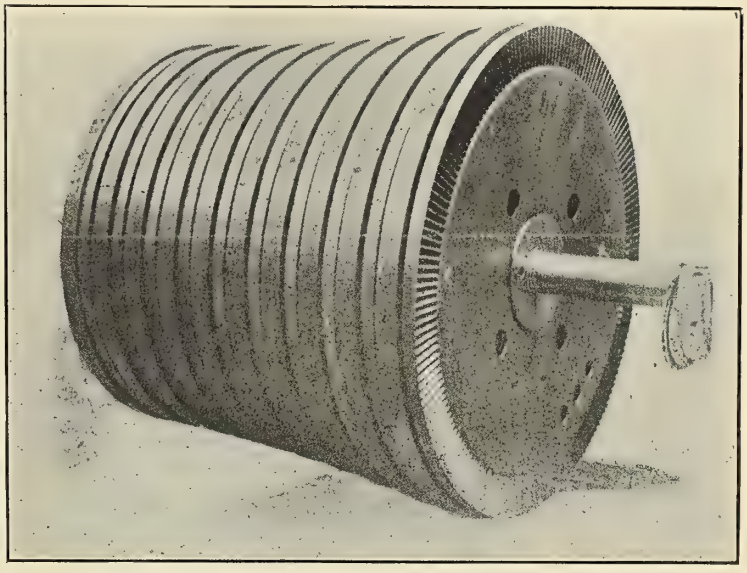


FIGS. 3 AND 4.

the radii of the shaft and the drum; and, moreover, friction being less to be feared at a place where the relative velocities are smaller, the play may be reduced to the absolute minimum. In practice we do not trouble about giving this play any precise value. We build the machine with practically no play round the shaft, and when started the machine itself makes play sufficient to turn without touching the internal rings of the diaphragms.

Friction of the Moving Parts on the Steam.—It would appear probable that multicellular turbines produce relatively large losses by friction of the moving parts upon the steam owing to the large surface of the moving wheels. This is, however, not the case. From tests which we have made to determine the law of friction, and also from the results of experiments made upon complete machines, we have found that frictional losses represent only from 2 to 4 per cent. of the normal power developed by the machine. These figures apply to turbines with an output exceeding 500 horse power. These figures are comparable with those obtained in drum turbines in which the friction of the moving vanes themselves must be added to that of the cylindrical surface of the drum.





FIGS. 5 AND 6.

Turbines with Groups of Wheels.—Another type of turbine which may really be considered as belonging to the impulse class is being built upon a large scale, and is known under the name of Curtis. In this type instead of using upon a single moving wheel the velocity of discharge of the steam leaving the distributor, it is used upon several wheels arranged in series in order to diminish the velocity gradually. The principle upon which the Curtis turbine is designed has been described, in 1890, by Mr. Mortier, in a discussion which took place after a paper had been read by the author upon steam turbines in general and upon the Parsons turbine in particular.*

*See Comptes Rendus de la Société de l'Industrie Minerale à St. Etienne. Meeting of April 12, 1890.

The type which we have described as having a group of wheels possesses the notable advantage of allowing a great reduction in the speed of rotation for wheels of the same diameter and of the same number. It would, therefore, be preferred to all others if it had not, in our opinion, the grave defect of preventing a sufficiently high efficiency being attained. It is easy to see that, owing to the great velocity of flow of the steam in the first wheels, the losses of energy by friction and eddying are very great, reaching such a value that the second wheel develops less power than the first, and the third wheel less power than the fourth, when more than two are used, and they act more like brakes than prime movers. The Curtis turbine, as originally constructed at the Fisk station in Chicago, had groups of four wheels, but the process of evolution reduced these to groups of three, and then to groups of two wheels. Even with such a reduction in the number of wheels in a group the efficiency, according to our calculation, is still at least 20 per cent. lower than that obtainable with the multicellular turbine which has only one wheel per cell. The author therefore ventures to think that the Curtis type of turbine will disappear, as in the process of evolution it will become the multicellular type pure and simple.

Description of the Rateau Turbine.—Since 1894, the firm of Sautter-Harlé, of Paris, with the assistance of the author, has been experimenting upon the construction of steam turbines. The first turbine constructed had only a single moving wheel, like the Laval turbines, and this wheel was formed with vanes in the form of a double arc, similar to the buckets of a Pelton wheel, and these vanes were milled out of a solid block of steel. This type has since been copied in the Riedler-Stumpf type, built by the Allgemeine Elektricitäts Gesellschaft, but which was rapidly abandoned, as it did not offer any chance of obtaining the maximum efficiency. The most recent Rateau turbine is of the action type; that is to say, expansion of the steam is fully carried out in the

distributor for each group consisting of a distributor and one moving wheel. The steam, therefore, acts by its velocity and not by its pressure. These turbines are, moreover, multicellular; that is to say, they consist of a certain number of elements, each element comprising one distributor and one moving wheel. A very interesting characteristic of the type of action turbines is the possibility which it allows of leaving very considerable play between the fixed parts and the moving parts, and this greatly facilitates construction and obviates the chances of dangerous friction if the bearings should become worn or the shaft somewhat bent. Besides this, the wheels revolve in a chamber where the pressure is uniform. There is, for that reason, an absence of longitudinal thrust upon the moving parts and no necessity for the use of dash pots for the purpose of overcoming the effect of this thrust, although such dash pots are necessary in re-action or drum turbines. Finally, in the action type partial injection of steam is possible; that is to say, the steam may be directed upon a limited portion of the circumference. The moving wheels are formed of discs of sheet steel more or less thin, and upon the periphery of these discs are riveted vanes of cylindrical form, Figs. 5 and 6. A steel band riveted to the periphery maintains the correct spacing of these vanes and insures great rigidity to the construction. Wheels so constructed are extremely light, and remain in equilibrium at a velocity far higher than that to which they are subject in the turbine. These moving wheels turn between circular diaphragms provided with distributing vanes which enter circumferentially into grooves formed in the interior of the turbine case. Between two adjoining diaphragms is therefore produced a cell or very flat chamber in which the moving wheel revolves. The shaft passes through the diaphragm in collars of anti-friction metal with very slight friction. In the first diaphragm which the steam passes through the distributing vanes are placed only upon a part of the circumference. Partial injection of the steam is therefore obtained, and thus the velocity of the steam is better utilized. Moreover, to produce the same effect the useful part of each distributor is set with an angular advance on the preceding section; this angle of advance is calculated according to the speed of rotation, so that the steam leaving one moving wheel enters into the following distributor and never encounters a solid wall which would produce a shock and therefore a loss of kinetic energy. For the last wheels it is necessary to employ total injection; that is to say, the distributing vanes must be set upon the whole circumference of the diaphragm, and, moreover, owing to the expansion of the steam, the radius must be increased. The bearings of these turbines are external, and by means of a special system of spring packing they are kept perfectly tight. No oil is carried by the exhaust steam to the condenser, and this has an important advantage, as the water of condensation can be used for feeding steam boilers direct without any necessity for the use of an oil separator. The speed of rotation is controlled by a centrifugal governor with a Denis compensator, which acts upon an obturator which controls the pressure of steam entering the turbine.

Mixed Turbines.—In the case of installations where exhaust steam must be used, a subject which we shall consider in detail at a later stage, it is often desirable to supply the turbines temporarily with steam at high pressure when the primary machine is stopped or is furnishing less steam, and the work done by the turbine must remain the same. In order to obtain economical working it is preferable not to expand this steam in order to lower it to the pressure for which the low-pressure turbine is built. Therefore, the author has designed a turbine which may be described as of the mixed type, and this can be supplied either simultaneously or separately by steam at high pressure and by steam at low pressure without any lowering of the efficiency of the mechanism. In order to attain this result the turbine is constructed in two parts, one designed for high-pressure steam and the other for low-pressure steam. The steam at high pressure having done work in the first portion will pass to the second portion, which may be fed either by steam coming from the accumulator or by the exhaust from the first portion. The admission of high-pressure steam into the first portion is automatically obtained by means of a special regulator which allows steam from the boilers to pass to the first portion as soon as the pressure in the accumulator falls below a given value. This arrangement, which has been adopted in all the new applications of the system to the use of exhaust steam, works very economically, and is particularly suitable to cases in which the primary machine works irregularly, and where, therefore, the demand for live steam is frequent and somewhat prolonged. In the small machines the two portions are usually joined together.

Efficiency of Turbines.—It is essential that the word efficiency should be clearly defined in order to avoid any misconception as to the figures which are given below. The author uses the expression "Theoretical consumption of the perfect machine" to denote the maximum work which the steam is capable of supplying when starting from the saturated or superheated condition in which this steam is delivered to the engine and expanding adiabatically with no loss of admission pressure P to exhaust pressure p. By comparing the actual consumption of steam as measured during the tests of the machine with this theoretical consumption of the perfect machine for identical conditions of pressure and similar states of the steam, the net efficiency of the machine is obtained. After special study of the question, the author has been able to draw a curve of theoretical consumption and to derive from it the following empirical formula for use when the steam is saturated and dry at admission:

$$K = 0.85 + \frac{6.95 - 0.92 \log P}{\log P - \log p}.$$

This formula gives the consumption K in kilograms per horse-power hour of 75 kilogrammeters as a function of the absolute pressures P and p expressed in kilograms per square centimeter. In British measures this formula becomes:

$$K = 2.13 + \frac{16.20 - 2.05 \log P}{\log P - \log p}.$$

K in pounds per horse-power hour, P and p in pounds per square inch. The curve which is given in Fig. 7 will readily afford interesting information, particularly if it be necessary to estimate the consumption of steam

with a given machine to obtain a certain useful effect. In that case the theoretical consumption per horse-power hour given by the curve should be compared to the exact consumption of steam actually observed with the machine, and of course referring to the particular number of electrical horse power developed by the dynamo driven, or to the power in water raised (expressed in horse-power hours), if pumps are driven by the machine. The relation between these two figures of consumption gives the combined efficiency of the group, and therefore takes account of all the losses of the steam engine and of the driven mechanism. This combined efficiency is merely the product of the efficiency of the prime mover multiplied by the efficiency of the machine driven. If the steam admitted to the turbines is superheated, then, of course, in estimating the theoretical consumption the extra calorific energy corresponding to the superheat must be taken into account;* but for the exact estimation of this extra energy we have not as yet adequate precise knowledge of the specific heat of the vapor of water. At present we have merely the figure obtained by Regnault after very cursory experiments (0.48), a figure which is merely a rough approximation.

The author has begun some experiments upon this subject from which he believes he will be able to prove that the true specific heat of steam is not constant, as has been usually supposed up to the present. It varies inversely as the amount of superheat, and is probably approximately unity for very small values of superheat, and approaches 0.40 for large amounts of superheat.

Calculation of the Efficiency of Turbines.—The efficiency of a turbine may be calculated *à priori* when a preliminary study has been made of the practical coefficients which must be introduced into the theoretical formula. We calculate this efficiency with quite a remarkable degree of accuracy by dividing the losses of the machine under two headings: first, the internal losses which are produced by friction and eddying of the steam in the fixed and moving vanes; second, the external losses which correspond to the leakages of steam in the play between the fixed and moving parts; and to the friction of the wheels upon the steam and to the friction of the bearings. The first kind of losses give rise to the *internal efficiency,* which may therefore be called the "hydraulic efficiency" by extending the use of the term employed for hydraulic turbines. This internal efficiency depends upon the more or less perfect form of the vanes, and also to the relation between the peripheral speed of the moving vanes and the speed of flow of the steam. It is possible to draw a curve showing the efficiency as a function of the peripheral velocity, and therefore it is easy to at once assign the degree of efficiency which a given turbine will realize.

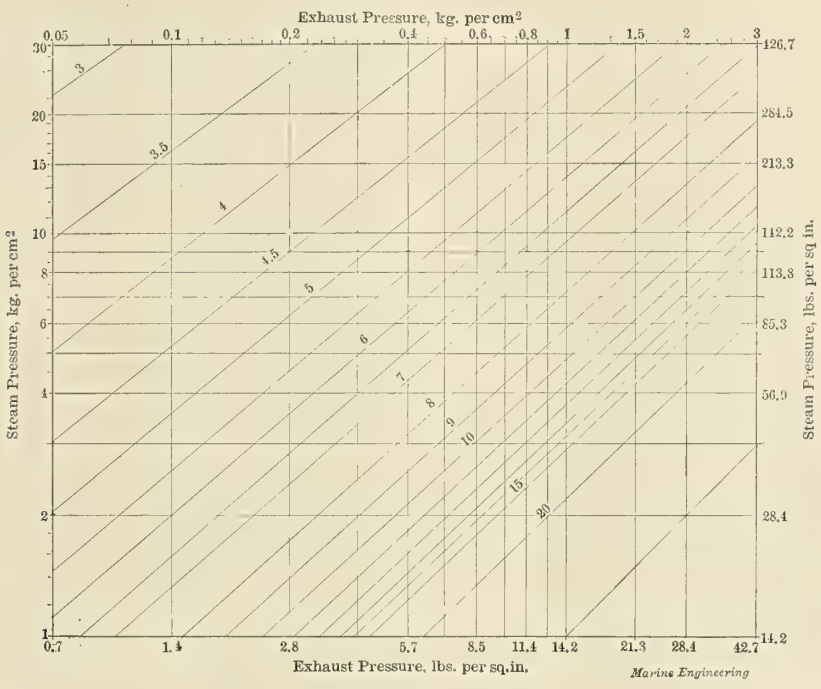


FIG. 7.

Once having fixed the internal efficiency, then, in order to obtain the net efficiency, we must deduct the losses by leakage as well as the losses by friction of the wheels upon the steam, and also those in the bearings. Let us take, for example, a multicellular turbine of 1,500 brake horse power upon the shaft with a speed of 1,500 revolutions per minute. By means of practical coefficients found by experience we can calculate that the internal efficiency of such a machine may easily rise to 69 per cent.; on the other hand, the losses by leakage and by friction in the bearings absorb 1.5 per cent. of the normal power, and the losses due to friction of the wheels upon the steam amount to 2.5 per cent., making a total for the external losses of 4 per cent. The net

*These results were published for the first time in the "Annales des Mines de Paris," in February, 1897, and since that date have, on many occasions, been republished in various French and foreign publications.

efficiency upon the shaft at the speed stated will then be .69 multiplied by .96 = .66. From this value of efficiency it is easy to calculate the consumption of steam per horse-power hour which would be required by this turbine under conditions of pressure and of superheat of the steam already determined. All calculations for designs of turbines that we have made by this means have always proved correct within 1 to 2 per cent. of actual practice. Such accurate calculations are not possible in the case of reciprocating engines owing to the action of the cylinder walls, which makes calculations uncertain and often inaccurate, whilst in the turbine the continuity of flow of the steam allows practical calculations of a high degree of accuracy to be based upon theory once having determined the fundamental coefficients which are employed in the formulæ. For a more detailed consideration of the use of these coefficients the author refers to the work which he published in 1903 in the *Revue de Mécanique,* entitled "Théorie élémentaire des Turbines à Vapeur."

The Results of Actual Practice.—The author began the construction of his first multicellular turbines in the year 1898 in collaboration with the firm of Messrs. Sautter-Harlé, of Paris, and there are now already at work, or in process of manufacture, turbines developing more than 25,000 horse power in units varying from 10 to 2,000 horse power, irrespective of the designs now in preparation. Some of these turbines are used for driving dynamos, others for pumps, for fans, and for the propulsion of vessels.

The author concludes with a brief abstract of the conditions and economical results of the most interesting of these installations. The applicability of turbines for driving fans is also pointed out. A field for the application of turbines for the utilization of exhaust steam from non-condensing intermittently-operated reciprocating engines is discussed at some length. For this purpose a steam accumulator consisting of a vessel containing solid and liquid materials is used, which he calls a fly wheel for heat. This system, if successful, would make it feasible for the utilization of considerable power which now goes to waste. The author's paper on "Steam Turbine Propulsion for Marine Purposes" was given in Marine Engineering for June, 1904.

Propellers Turning Outboard.—The engines of all future British naval ships, according to London *Marine Engineer,* are to be so designed that the screw propellers will turn outwards for driving the vessel ahead. For some time the practice has been to fit the engines to turn the screws inwards, but experience has shown that this causes a loss in manœuvering qualities, and also in propulsive efficiency, especially where the propellers work close to the hull of the ship. A London correspondent of the *Glasgow Herald* has pointed out that experiments in Italy confirmed this view, which is entertained by many officers in the service. In the French Navy experiments have been made with the same result, and, as a consequence, it has been decided that all small cruisers and torpedo craft shall be fitted with outturning screws. The Admiralty, however, has made the change operative on all ships. One of the advantages of the in-turning screw was that the engineer's platform could be in the center of the ship, so that he had full control and view of both engines. In the merchant service this advantage is got even with outturning screws, but to obtain this result it is necessary to have heavy columns or frames in the front of the engines, so as to take up the thrust of the cross-head and connecting rod. Not only would extra weight be involved in this change—an important consideration in warships—but the view of the engine would be restricted. In naval machinery round forged-steel columns are now used in all cases, and the engineer in charge can see all parts at a glance, and can ascertain easily if any part of the machinery shows a tendency to heat. In the new cruisers the starting platform will be in the wings of the ship, the back columns of the cast-iron form with slipper guides for the thrust of the crossheads and connecting-rod being placed next to the longitudinal bulkhead which separates the two engine-rooms.

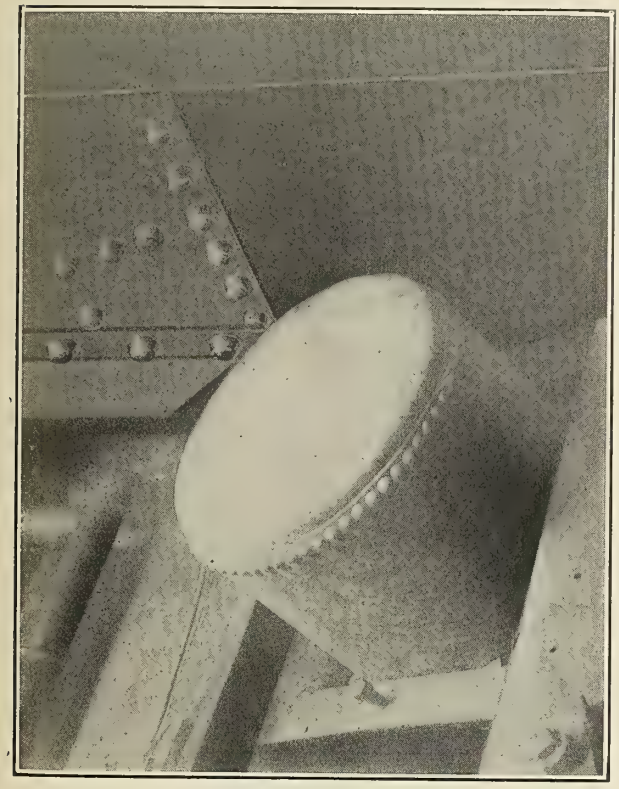
Progress of Naval Vessels.

The Bureau of Construction and Repair, Navy Department, report under date of June 13, 1904, the following degree of completion of vessels building for the United States Navy:

			Degree of Completion. Per Cent.	
BATTLESHIPS.			May 1.	June 1
Ohio	18 knots.	Union Iron Works	93	94.5
Virginia	19 "	Newport News Co	59.4	61.2
Nebraska	19 "	Moran Brothers Co.	46.9	49
Georgia	19 "	Bath Iron Works	52	54.13
New Jersey	19 "	Fore River S. and E. Co	57.6	58 7
Rhode Island	19 "	Fore River S. and E. Co.	59.8	60.7
Connecticut	18 "	Navy Yard, New York, N Y.	38.46	42.1
Louisiana	18 "	Newport News Co.	47.91	49.31
Vermont	18 "	Fore River S. and E. Co.	6.8	8.9
Kansas	18 "	New York Shipbuilding Co.	7.5	9.6
Minnesota	18 "	Newport News Co	26.15	29.59
Mississippi	17 "	Wm. Cramp and Sons	2.3	3.5
Idaho	17 "	Wm. Cramp and Sons	2.2	3.2
ARMORED CRUISERS.				
Pennsylvania	22 knots.	William Cramp and Sons	76.9	80.5
West Virginia	22 "	Newport News Co.	83.4	85.49
California	22 "	Union Iron Works	60	60.5
Colorado	22 "	William Cramp and Sons	80.9	84.9
Maryland	22 "	Newport News Co.	78.88	82.8
South Dakota	22 "	Union Iron Works	55.5	57.5
Tennessee	22 "	William Cramp and Sons	28.9	34 4
Washington	22 "	New York S. B. Co.	24.2	29.3
PROTECTED CRUISERS.				
Denver	17 knots.	Neafie and Levy	99.9	100
Des Moines	16½ "	Fore River S. and E. Co.	....	. ..
Chattanooga	16½ "	Lewis Nixon	80.01	84.23
Galveston	16½ "	Wm. R. Trigg Co	78	81
St. Louis	22 "	Neafie and Levy Co.	41.2	42.6
Milwaukee	22 "	Union Iron Works	48	50.5
Charleston	22 "	Newport News Co.	69.7	73.1
GUNBOATS.				
Dubuque	12 knots	Gas Engine and Power Co.	40	42.6
Paducah	12 "	Gas Engine and Power Co.	33.6	35.7
TRAINING SHIPS.				
Cumberland	Sails	Navy Yard, Boston	35	42
Intrepid	"	Navy Yard, Mare Island	16	23.3
TRAINING BRIG.				
Boxer	Sails	Navy Yard, Portsmouth	34	42
TORPEDO BOATS.				
Stringham	30 knots.	Harlan and Hollingsworth	93	96
Goldsborough	30 "	Wolff and Zwicker	99	99
Blakely	26 "	George Lawley and Son	99	99
Nicholson	26 "	Lewis Nixon	99	99
O'Brien	26 "	Lewis Nixon	98	98

Submarine Bell Signaling.

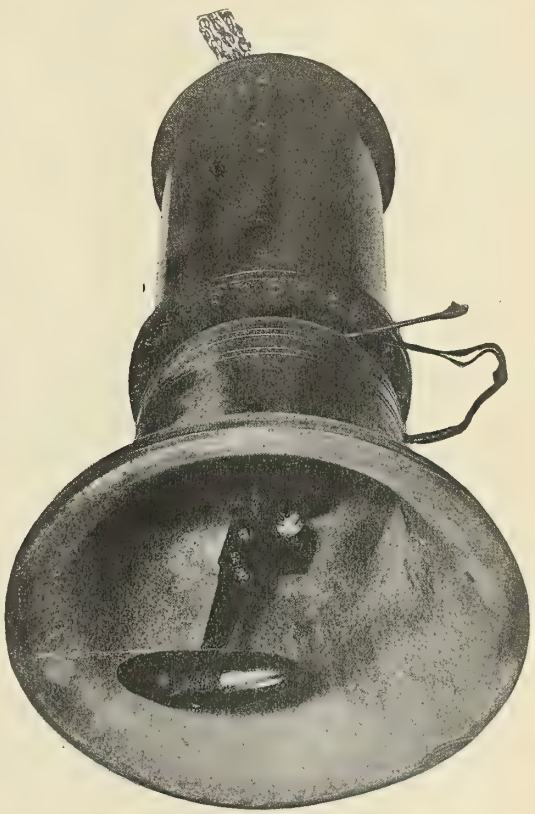
Recent tests have proved conclusively that the system of submarine signaling by means of sound with water as a medium is an assured success, and this remarkable achievement marks an era of distinct progress in the science of navigation. For more than two years repeated experiments have been made toward the accomplishment of this end, for, notwithstanding the improvements incident upon the use of steam power in battling against the elements, the great menace to navigation arising from the snows, fogs, and high winds of winter and spring has heretofore remained practically unalleviated.



CYLINDER IN WHICH RECEIVING MECHANISM FOR SUBMARINE BELL SIGNALS IS PLACED.

It is easily seen that signaling by means of lights and fog whistles is fraught with uncertainty and disadvantage, the success of thus warning ships of danger depending entirely upon atmospheric conditions. A driving snow may preclude the possibility of seeing the lights, and the roar of the tempest may with equal certainty destroy the sound waves of a whistle before they could reach the mariner. Since the atmosphere is so unstable it would seem that to water alone, which is virtually unchangeable, and which as a conductor of sound has four times the power of air, must we look for a solution of the problem, giving us a means of signaling that will be equally efficient in foul weather as well as fair.

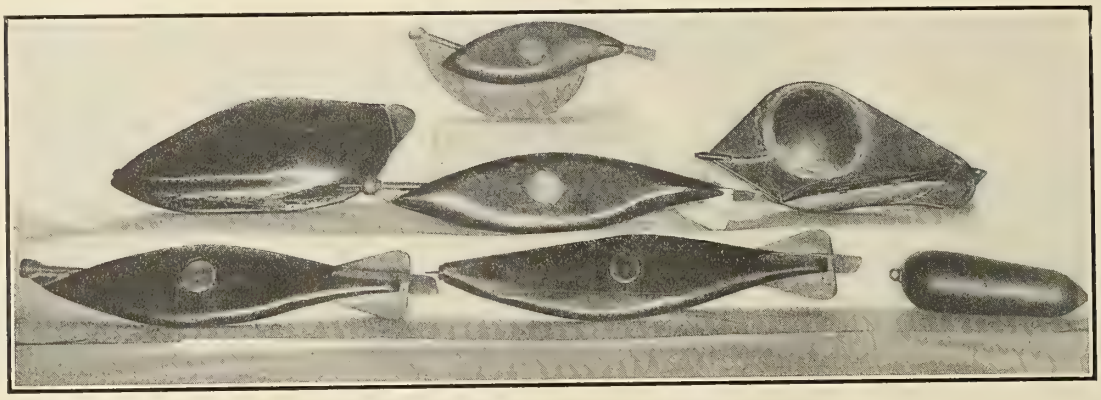
Working upon this theory, Mr. Elisha Gray began the invention of a mechanism that would collect and transmit the sound through water. But this inventor died when his efforts were only in an experimental stage, and others have succeeded him with the investigations. As a result, an organization known as the Submarine Signal Company was finally formed, which through many experiments developed the apparatus, until to-day the efficient transmutation of sound through water for uses of navigation has been accomplished. The chief feature of the apparatus consists of two magnetic transmitters peculiarly sensitive to sound, which are in cases in two small cylindrical iron tanks, open and flanged at one end. One of these tanks is shown on this page. These tanks are placed one on the starboard and one on the port side of the ship, below the water line, close to the stem, a hole is cut in the shell, and over this the flanged end is riveted. These transmitters receive the sound waves, and wires convey the electric impulses to the pilot house, where an apparatus similar to the usual telephone receiver makes it possible for the captain to hear the sounds in the water within several miles of his ship. There is a switchboard in connection with the telephone by means of which it is possible to tell from which side of the vessel the sound proceeds. If, by moving the switch to starboard, the sound becomes diminished, it is known that the source of the sound waves is on the port side, and *vice versa*. If, however, the sound may be heard with equal distinctness from both port and starboard sides of the ship, it is inferred that the bell or other object producing the sound is head-on. And, so delicate and accurate is the apparatus that the direction may be determined within a quarter of a point of the compass.



1,000-POUND ELECTRIC BELL FOR SUBMARINE SIGNALS.

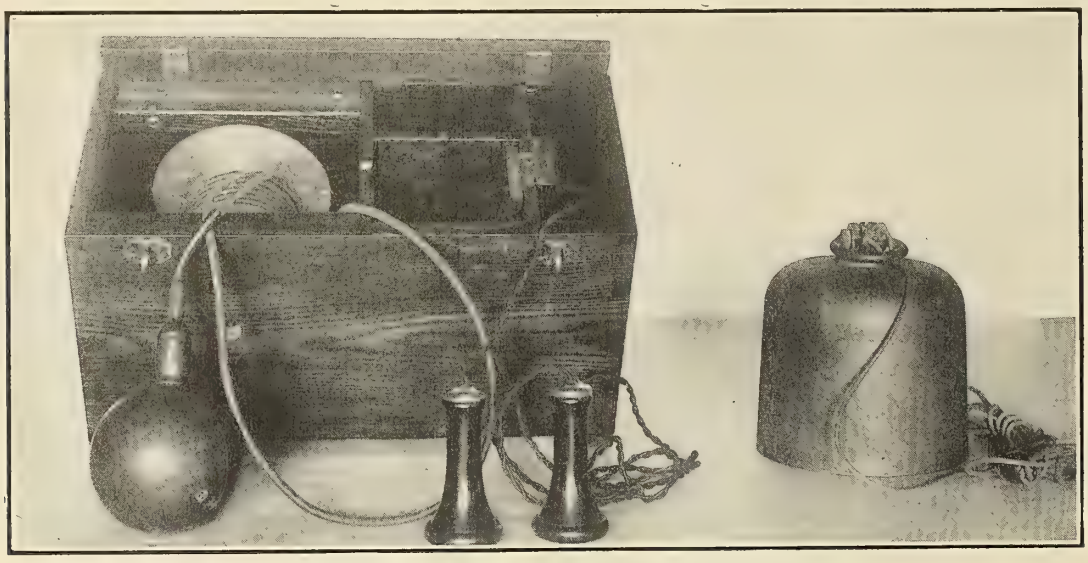
To further facilitate the use of these instruments, there is a sort of speaking-tube attachment reaching from the receiver to the fore part of the pilot house, so that the captain, by making the connections, may receive the sound messages without leaving the wheel.

To use the signaling invention necessitates the equipment of lighthouses with bells of special manufacture. has the advantage of being portable. A large wooden chest, capable of being moved to any desired position on the vessel, holds this useful apparatus—the battery, telephone receivers, and coils of electric wires, at the end of which are attached the fish receivers. These latter appliances, corresponding to the stationary tank-enclosed transmitters on the two sides of the ship, are thrown



FISH RECEIVERS FOR SUBMARINE BELL SIGNAL OUTFIT.

These bells, sometimes of 1,000 pounds' weight, wrung by electric power ,are placed at a distance of 25 feet or more below the surface of the water, and their constant peals, heard by passing ships that are provided with the signal apparatus, may be conveyed at present a distance of six or seven miles. A second valuable overboard to a depth of from 15 to 50 feet, and are so constructed that they register the sound vibrations as do the fixed receivers. But, although supplying a certain need to these small sailing vessels, they are less satisfactory than the larger mechanism, since accident to the submerged wires may detach the fish receivers,



BALL RECEIVER AND DORY BELL FOR SUBMARINE SIGNALING.

application of the service is suggested by the exchange of signals between ships in time of war, and still farther could the utility be carried in locating the position of vessels by listening for the sound of the screw, the equipment of both vessels with apparatus not being a necessary condition.

For small fishing smacks and other craft not fitted up with the usual conveniences of the pilot house, a modification of the apparatus just described is made, which whence they would be lost at sea. Vessels using this movable signaling service are also supplied with dory bells, by means of which they may signal to passing craft.

For several months the four steamers of the Metropolitan line have been equipped with the apparatus of the larger type, and tests were made on the *James S. Whitney,* on a trip from New York to Boston, when Canadian and American government officials, naval

officers, and others were present. Signals were satisfactorily transmitted between the ship and the temporary apparatus placed on the Vineyard sound lightship and Boston light. The ringing of the 650-pound bell, sunk 25 feet below the lightship, was heard five miles away.

On this same trip the ringing of the bell in the fore peak of the *H. M. Whitney,* en route to New York from

RECEIVING DEVICE, MOVING THE SWITCH TO DETERMINE WHETHER THE SOUND COMES FROM STARBOARD OR PORT SIDE.

Boston, was detected when the ships were within an estimated distance of three miles of each other.

These demonstrations of the usefulness of this new contrivance for the prevention of accident at sea, places it upon a sure footing, and ranks the submarine bell-signaling service as a boon to ocean and coastwise traffic.

New Staten Island Ferryboats.

The Maryland Steel Company, Sparrow's Point, Md., has been awarded the construction of the five steel screw-propelling ferryboats for the Staten Island ferry service by the city of New York. The plans and specifications are drawn by consulting naval architects Millard and MacLean of New York city. The boats were built for the Department of Docks and Ferries, Maurice Featherson, commissioner. The bids were opened in the commissioner's office, June 17, from eight shipbuilding firms, and were so close that they reflected credit both on the manner in which the specifications were drawn and the care with which the bids were prepared.

There were two classes of bids, Class X calling for the installation of Babcock & Wilcox or Niclausse boilers, and Class Y, which calls for Mosher, Hoehenstein, or Seabury boilers. The bids were received as follows, the first amount being for one boat, and the succeeding amounts for each additional boat:

Class X: Harlan & Hollingsworth, $362,000, $341,00, and $331,500; Bath Iron Works, $355,900 and $347,900; Burlee Dry-Dock Company, $345,000 and $341,000; H. F. Palmer, $352,000 and $347,000; Eastern Shipbuilding Company, $350,000 and $345,000; W. & A. Fletcher Company, $365,000 and $346,300; Wm. Cramp & Son Ship and Engine Building Company, $350,000 and $340,000; and Maryland Steel Company, $365,500, $349,200, $341,200, $341,700, $327,600, and $325,000.

Class Y: Harlan & Hollingsworth, $341,000, $320,000, and $312,000; Bath Iron Works, $340,100 and $332,100; Burlee Dry-Dock Company, $335,000 and $329,000; H. F. Palmer, $338,000 and $333,000; Eastern Shipbuilding Company, $335,245 and $326,245; W. & A. Fletcher, $365,000 and $346,300; Wm. Cramp & Son Ship and Engine Building Company, $340,000 and $330,000; and Maryland Steel Company, $351,500, $337,000, $331,200, $319,000 and $317,000.

The contract awarded to the Maryland Steel Company was for Class X, and amounts to $1,709,000.

All the vessels are to be delivered in one year from date of signing contract. The general dimensions are: length over guards, 250 feet; length to outside of stern posts, 247 feet; length to outside of propeller posts, 218 feet; breadth of hull molded at deck, 46 feet; breadth over guards, 66 feet; depth, molded, 19 feet 6 inches; draft to bottom of keel, 12 feet; freeboard, 7 feet 6 inches.

The boats are of the double-deck type with large cabin on upper deck. The hull is of steel throughout. The center house will be of steel and between the wagon ways and the cabins will be longitudinal steel bulkheads.

Each boat will have two inverted, direct-connecting, 2-cylinder compound-surface condensing engines, each set with cylinders 22 1-2 by 50 inches diameter by 30 inches stroke. The two sets of engines are to be coupled together at the crank shafts. There will be two boiler rooms, one at each end of the engine room, and the grate surface of the boilers shall be not less than 340 square feet, and the heating surface not less than 125,000 square feet; the working pressure is to be 225 pounds per square inch. Forced draft on the closed stoke-hold system is to be provided. Each boat is to be electric-lighted throughout with 475 incandescent lamps, the current to be supplied by two direct-connected generating sets 25 Kw. each.

The cabins are to be heated by the hot-air system, fresh air being taken from outside, heated over coils and delivered at the top of the cabins.

Full particulars and plans of these boats will be given in succeeding issues of Marine Engineering.

Submarines for Japan.—Considerable interest was aroused in the mysterious movements of the steamer *Fortuna* off the Atlantic coast recently. She sailed presumably for Japan, and has on board one of the Lake torpedo boats. The president of the submarine company has left for the Orient.

Turbine Yacht.—The third English-built turbine yacht to be enrolled in the American yacht clubs, is the *Lorena,* which recently arrived in New York bay. She is of the large cruising type, designed by Watson, and is owned by Mr. A. L. Barber.

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Notice to Advertisers.

Changes to be made in copy, or in orders for advertisements, must be in our hands not later than the 15th of the month, to insure the carrying out of such instructions in the issue of the month following.

THE most appalling calamity that has in many ways ever been recorded, occurred, as all of our readers are aware, on June 15, when the excursion steamer *General Slocum* took fire, burned to the water's edge, and sank at the entrance of Long Island sound. The horror of this accident, in which over nine hundred helpless women and children perished from fire or drowning, is most appalling. Many heart-rending cases, in which whole families were destroyed, have thrown the city and country into deep grief. The daily papers have given full details of the accident and accompanying scenes. Nothing can be done for those who have been lost, and but little assistance may be rendered to the survivors in their deep grief regardless of the amount of subscription which is now being raised for the destitute. All that can be done is to investigate into the causes which brought about such fearful destruction, to place the responsibility, and to pass such laws covering the construction and inspection of such vessels as will prevent a repetition of the catastrophe. At the time of writing, the most plausible reason advanced as to how and where the fire broke out is that it occurred in the lamp and paint room in the forward hold. When it was discovered the fire hose was connected up and the fire pumps started, but all to little avail, as the fire was already raging, and the mate is quoted as stating that the hose gave way in a dozen places. Gaining headway instantly, the fire enveloped the boat in smoke and flames, and the feeble efforts of the fire fighters amounted to naught. At the time of writing investigations are under way by Federal and city authorities, and it looks as if the loss of life were much greater than should have been if the life-saving apparatus had been in good condition. It is stated the life preservers were filled with powdered cork and the canvas covers were rotten.

The reasons of the captain's determination to run his vessel aground at North Brother island, fully fifteen minutes beyond the nearest shoal water, and at a time when every minute meant dozens of lives, does not as yet appear clear. At this crisis his judgment alone had to be depended upon. At every foot of the way the flames which broke out forward were carried back by the head wind, dealing death and destruction on all sides. Whether or not the captain's decision was right is a matter of opinion, but the unflinching way in which he and his two pilots stuck to their posts until after the boat had grounded, while the very pilot house was burned away from them, shows the true heroism of the men, and, in fact, the only bright spots in this fearful scene are those of sacrifice, bravery, and heroism shown by some of the rescuers.

Concerning the responsibility for this accident, it should first be stated that the *Slocum* was duly inspected on May 7, of this year, by United States steamboat inspectors and certified to be in good condition to carry 2,500 passengers, to be fully equipped with life-saving devices, and to comply with all regulations of the laws. Who, then, is to blame for the catastrophe, and what is to prevent a similar one happening to dozens of other excursion steamers built and equipped in a manner similar to that of the *General Slocum?* As the steam craft of our harbors are under the supervision of government officials, the public has the right to infer that such vessels are reasonably safe to travel on, otherwise what value is the government guarantee? It is impossible for each passenger to make an examination into the fire equipment, the soundness and the stability of every vessel he takes passage on, or that he engage an expert to make such inspection for him. The vessel's

certificate of inspection, granted by the government, is for just such purpose. The obsolete, inefficient, and insufficient rules governing the inspection of steamboats has been a subject of continual appeal to Congress. These rules, which were laid down many years ago, have long since outlived their usefulness, and only deal with present construction through innumeral disconnected amendments and revisions. In the last session of Congress a bill was introduced to improve the steamboat inspection service, but although it passed the Senate and was an administration measure it was held up in the House. Sad it is to comment that all measures of relief seem only to be secured after some horrible calamity. The inertia of indifference, or carelessness of officials of the government or of private corporations, or, in fact, the individual, can only be overcome by a fearful lesson.

That the *Slocum* disaster may not be repeated, it is primarily essential that a fundamental change be made in the construction of these vessels. Such an accident on board an ocean-going steamer, built of steel and subdivided with steel bulkheads, would be impossible. In an excursion or river steamer, where all the passengers are accommodated in wooden deck houses or on decks built entirely of wood, whether or not the hull were of steel would make little difference. It appears then that the necessary constructive changes should be made such that the upper works be built of steel, asbestos, or other fire-proof construction, and that light metal bulkheads subdivide the deck space. One means of protection suggested is that asbestos curtains, or asbestos bulkheads hinged on the beams to swing down in place be so placed as to suitably subdivide the deck space. Also, very efficient and complete fire-fighting apparatus is absolutely essential. In our theatres, where the public congregate in great numbers, the law is very rigid regarding the fire-proof construction and fire protection. Members of the fire and police departments are always in attendance to prevent panic and direct in putting out the fire.

It is now positively asserted that the crew had never been trained in the fire drill or in launching the boats. In fact, it is stated, that it was impossible to launch the life boats. So far the evidence in the examinations of witnesses and conditions tends to indicate criminal negligence on the part of the steamboat company and inefficiency on the part of the steamboat inspection service. While the horrors and loss of life of the accident might have been lessened, it is evident that the laws governing the construction and inspection of vessels must be changed before immunity of such disasters in the future may be reasonably expected.

At the sessions held in New York, Philadelphia, Baltimore, and Boston, of the American Merchant Marine Commission, appointed to investigate the condition of the present state of the American shipping and shipbuilding, and to report to the next Congress, testimony advocating about every conceivable system was given. The commission has an arduous task before it. In the first place, the bill creating this body is considered but a shrewd political move to put off till after the next election any congressional action on this subject. Congress has repeatedly attempted to enact some form of shipping subsidy, but as yet no policy has been formulated which will be acceptable, and the responsibility for such a policy has now been laid upon the shoulders of this commission. It is almost useless to hope that the entire commission may unite on one policy, as it is composed of members of both parties, and hence there is almost sure to be a minority report, however the tales of distress of present conditions, given at the hearings, are sure to impress each member, whether Democrat or Republican, that something must be done, and that speedily, or the American flag will be obliterated from the ocean.

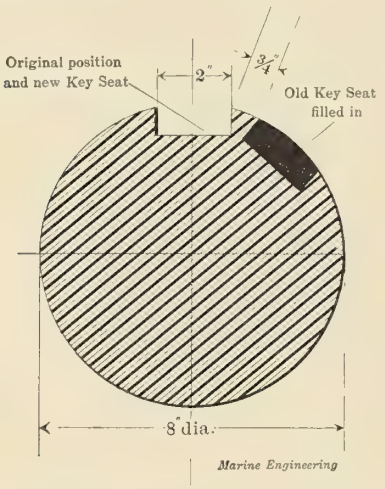
The testimony given at New York was, generally speaking, lamentably weak and diversified. Advocates of mail subsidies, differential duties, bounties on exports, subsidies on cargo vessels, bounties to the shipbuilder, each presented his case for alleviating present conditions. Several shipbuilders testified of the very great increase in cost of American-built ships. The testimony in Philadelphia, Baltimore, and Boston, was practically a reiteration of the opinions expressed in New York. Taking it all together, the preponderance of evidence seems to be in favor of either mail subsidies to regular steam lines to distant markets, or preferential or discrimating duties in the indirect trade. While it is hoped that the commission may be able to formulate some plan generally acceptable, the testimony so far taken does not give assurance that this will be the case.

Queer Damage to Rudder Stock.

Editor Marine Engineering:

Possibly some of your readers will be interested in a peculiar accident which came under my notice some time ago, and before the Dominion government had erected the plant for lighting the Welland canal. One of the large wooden steamers running between Ogdensburg and the upper lake ports was coming down this canal from Lake Erie on a very dark night. On account of the slow speed, the vessel lost steering way, and the stern swung round and drove the rudder into the hard clay bank.

When freed it was found that the steering gear was deranged, making it necessary to tie up till daylight. By means of cables the steamer was warped to the town of Welland, where there is a machine shop. The chief engineer came over to the shop and asked for a man, a couple of sets of chain blocks, and a small set of sheer legs we happened to have handy, to help him to unship



SECTION SHOWING TWIST IN RUDDER STOCK, AS RESULT OF ACCIDENT.

the rudder stock. The rudder and stock were coupled together by means of a large flange coupling. The stock was 8 inches diameter, about 9 feet long.

The main bearing for the rudder was at the deck above, and about 12 inches below the bearing was keyed the tub of the quadrant, the key seat being about 18 inches long.

The shaft and quadrant were brought to the shop where careful examination showed nothing wrong with the quadrant, but on looking at the shaft the key seat was found to be twisted into a long spiral. However, not a sign of crack or flaw could be detected in the shaft, not even an appreciable bend, so the chief ordered us to fill up the old key seat, cut a new one, key on the arm, and re-erect as soon as possible.

The accompanying figure shows a section of the shaft with dimensions of the change made, it being understood there was not the slightest displacement at the coupling end. In fact, the new key seat was laid off from the position of the coupling. The old key seat was filled up as solid as possible, the surface being turned off in the lathe. Repairs were complete late in the evening and the steamer proceded on her trip. Unfortunately, I have no dimensions of the steering quadrant arm whereby an idea of the force exerted could be calculated, but it must have been very great.

Robert Logan Hamilton.

A Marine Experience.

The following is taken from a communication to *Power* by an engineer named Thomas Grieve.

"Some years ago I was appointed to take charge as chief engineer in a steamer which was then bound from Liverpool to Baltimore, by the way of Genoa, Italy. I was advised by the superintendent of the line that the ship was nine months old, and that as far as the engines were concerned, they were a failure. The builders of the engines had had their men running them, but with very indifferent success. I was required to go there and find out the cause of the abnormal consumption of coal, the slow speed, etc. As the steamer was nearly ready for sea, there was no time for overhauling. However, I picked my own men. We started out, and the engines handled fairly well getting out of the docks, but we found we had caught a Tartar by the time we got to be fairly under way. The engines were of the vertical compound type, with cylinders 34 and 64 inches, with 39-inch stroke, fitted with double eccentrics and Stephenson link motion on each engine, steam reversing gear and surface-condensing. There was a very heavy pound on the crank centers of both engines, and the main journals were overheating quite frequently. We could not get any more than 18 to 20 inches of vacuum, and, although we had good coal, the steam was very hard to keep up to our working pressure of 90 pounds. After being two days out and having good weather, I tried the indicator and found practically a good card, only a slight lack of compression; but the admission and expansion lines were good. The want of steam led me to believe that we were carrying steam too far on the stroke, but cutting off shorter by the link motion only made the pounding on crank pins worse.

"In the meantime some one had found in the store room a set of laths or wood tempates marked off to show the ports on the cylinder face and valve. This was a lucky find. I got a piece of board and cut out a circle large enough to get a pin in at a point half the throw of the eccentric, which I found to be 8 1-8 inches. I drilled a hole in the center of this board and fastened it to the partition wall in a cool place, where I could do some thinking. After laying off half the throw on this board I made a wooden eccentric rod and fastened the lath of valve face to it. Fastening the lath of cylinder face securely to partition, I traversed the lath of valve over lath of cylinder face, noting at each position of the valve in what position the piston in the cylinder was, which was found by taking the ratios of stroke of the piston and valve. I assumed that the valve must have about 1-8-inch lead, and from that standpoint I found the cut-off for steam, and likewise the operation of the exhaust ports. By the way, the valves were the gridiron, double-ported valves. After deliberation I increased the lead to 1-4 inch, and found that the steam would be cut off 2 1-2 inches on the stroke earlier. The exhaust I concluded would take care of itself until further developments.

By this move the board showed that all the eccentrics would have to be advanced 1-2 inch on the shaft. However, I eventually decided to try this alteration. When we arrived at our first stopping place, all hands were put to work. The eccentrics, I think, were 30 inches diameter, put in with keys, 3 inches wide by 1 inch, sunk in the shaft. We chipped out enough in the eccentric keyway to advance 1-2 inch and fitted in a temporary key alongside of the permanent one, making it secure by caulking over the end of the permanent key. As our time was very limited, we had not time to look at the valves, but I felt sure of my ground. After examining the pumps to find out what seemed to be the matter with our vacuum, we found everything in order; but after taking down the condenser ends, it struck me forcibly that the condenser was too full of tubes, which were 7-8-inch brass, with wooden ferrules to fasten in tube sheet. I drew out fifty of these tubes, starting wide at the top and tapering down to the center for five rows. After plugging these holes with wooden plugs we closed everything up, and were ready to get under way. The first few revolutions of the engine demonstrated that we had done the very thing that had been needed. The consumption of fuel went down, and we made a substantial gain in speed. The boilers showed ample steaming capacity, and we had no trouble in holding 26 inches of vacuum, due to the fact that the exhaust steam was distributed around the condenser and coming in contact with the cooling surfaces. I steamed about 7,500 miles in this steamer after this and had a very comfortable job. Needless to say that the engineering force received congratulations from the owners of the line when we arrived at our destination."

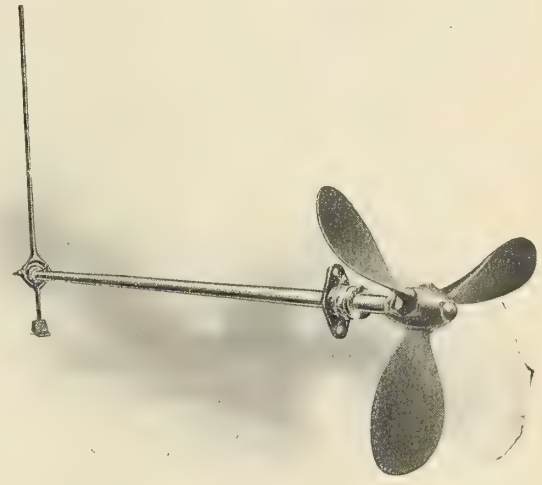
Contracts for Government Ships.—It is now expected at the Navy Department that contracts for the battleship and two armored cruisers, authorized by the last Congress, will be advertised early in September. The general plans of the battleship will closely follow those of the *Connecticut* class, both in displacement, over all dimension, armor and armament. The submerged torpedo tubes will be fitted. The engines are to be the usual 4-cylinder, triple-expansion type, aggregating 16,500 horse power, and it is probable that twelve Babcock & Wilcox boilers will be installed. The armored cruisers will be of 14,500 tons displacement, and practically identical to the *Washington* and *Tennessee*. The plans of the three high-speed scout vessels are not progressing so rapidly, and it is doubtful if contracts for these vessels will be advertised as early as September. The present machinery plans are for turbine propelling engines. The two colliers authorized, to be built in navy yards, to carry 5,000 tons of coal, and to have a speed of 16 knots, will probably not be commenced till after the next Congress has met. The appropriation for each vessel was $1,250,000, but no appropriation was made for equipping the navy yards wherein they should be built. As at present the only navy yard building slip equipped for such work is at Brooklyn, and there the slip is at present occupied by the battleship *Connecticut*, this work must of necessity be postponed.

ENGINEERING SPECIALTIES.

Reversible Propeller.

The annexed cut illustrates the Geyer reversible propeller, for which strong and simple construction and durability are claimed. It consists in brief of three parts: shaft, hub, and blades. According to design it is made in a two- or three-blade type.

The hub, or sleeve, has a certain amount of slip on the shaft and each blade is pivoted to the hub. Below



NEW TYPE OF REVERSIBLE PROPELLER.

each blade base and extending through the hub is a pin set into the shaft and this pin fits into a recess in the blade base. Shifting this sleeve backward or forward on the shaft by means of the lever will, as is evident, turn each blade about its pivot.

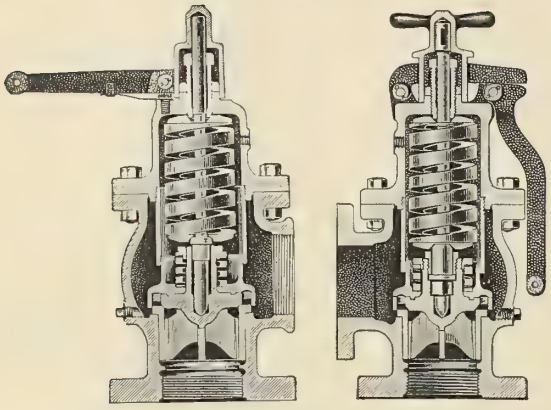
For further securing the blade the periphery of the blade base sets into a recess in the hub. The hubs, blades, and stuffing boxes are made of excellent quality of bronze, and all shafts are of tobin bronze, 6 feet long. W. E. Geyer, 373 Washington street, Boston, Mass., is the maker.

Pop Safety Valves.

The Crane Company of Chicago has brought out a number of improved forms of pop valves for stationary, marine, locomotive and portable boilers. The principal points of interest are shown in the accompanying illustrations of the pop valve and the marine valve. The chief point of interest of the pop valve is a self-adjusting feature, which automatically regulates the pop of the valve. In all pop valves it is necessary to have a pop or huddling chamber into which the steam expands when the main valve opens, thereby creating a valve-lifting force corresponding to this increased area, and greater than the force of the spring. Thus the valve is held open until the pressure is relieved. Means must also be provided to relieve this pop chamber of this pressure in order to allow the valve to close properly.

In this valve this is accomplished by a self-adjusting auxiliary valve and spring which are independent of the main valve and spring. The steam in pop chamber finds a passage through holes or ports into an annular space provided in the auxiliary valve or disk, and by reason

of the light auxiliary spring this pressure lifts the auxiliary valve and allows the steam in pop chamber to gradually escape, thus permitting a greater range in setting pressures with the least waste of steam, and, at the same time, supplying a cushion or balancing medium, thereby preventing any chattering or hammering and affording the easiest possible action in closing.



SECTIONS OF POP VALVES OF THE ORDINARY AND MARINE TYPES

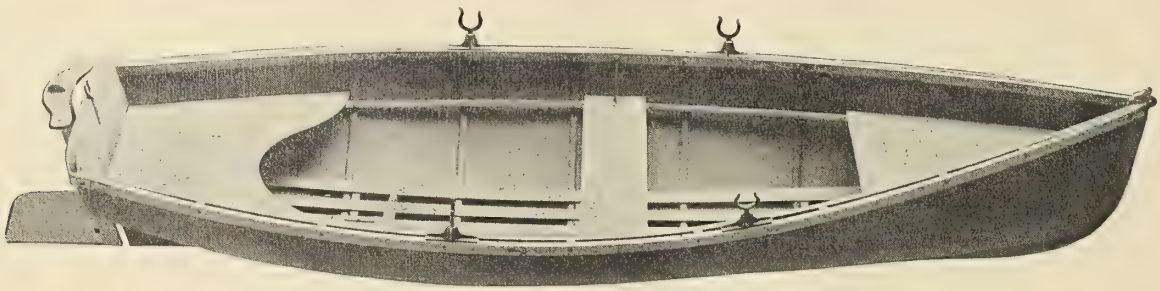
In some of the designs the chamber or casing incloses both springs, protecting them against the action of the steam, particularly high pressure, which, blowing with great force and velocity throughout all parts of valve before reaching the atmosphere, would otherwise have a tendency to disarrange the springs and other parts operating in connection therewith.

This form of valve is also particularly useful, in fact, necessary, where a number of valves may be connected to one main exhaust or discharge pipe. The encased spring chamber, extending over a greater portion of the top surface of the main valve, prevents any retarding action of the steam due to back pressure, which might be caused by one or more valves opening slightly in advance of another, in having any material effect on the free opening of the other valves.

The marine pop valve, which has been approved by the United States Board of Supervising Inspectors, has the same self-adjusting pop regulator as described above. The seats are beveled at an angle of 45 degrees from the center line of axis and are made of a composition of solid nickel bushing. The cam lever is capable of lifting off its seat on-eight the diameter of valve open, whether or not there is pressure on the boiler. The cam lever may also be thrown far enough over to lock the valve open should occasion require. The cap is made with handles and fastened to the stem by a key, and the stem in turn is securely attached to the main valve, and by turning the stem it is possible to turn the valve on its seat, thereby removing any incrustation that may accumulate. The springs are incased and made of best steel, with self-adjusting strong disks. The valves may also be taken apart without removal from boiler and without disturbing the outlet pipe. All parts have been so designed and proportioned that when fitted and adjusted with correspondingly strong springs the valves are suitable for pressures up to 250 pounds.

A Sheet Steel Yacht Tender.

The cut shows a thoroughly strong and seaworthy sheet steel yacht tender or dinghy, made by W. S. Mullins, 519 Depot street, Salem, Ohio. This is a very light and strong boat of fine model and is absolutely water tight. In either end air tanks are fitted which, in case the boat should capsize and be filled with water, will not only prevent it from sinking, but have sufficient buoyancy to keep above water several persons clinging to it. The boat has oak frames, to which are riveted sheet steel plates pressed to form. These plates are lap riveted and the joints soldered, making a very strong and water tight construction. The gunwale is strengthened with inside and outside wooden wearing pieces. The woodwork is of the best selected material, natural finish. Eyebolts are placed at the bow and stern for taking the davit block hooks. The smooth surface of the steel sides, fine model and light weight make this boat exceedingly easy to row, and the result of several years' experience proves it to be strong and durable.

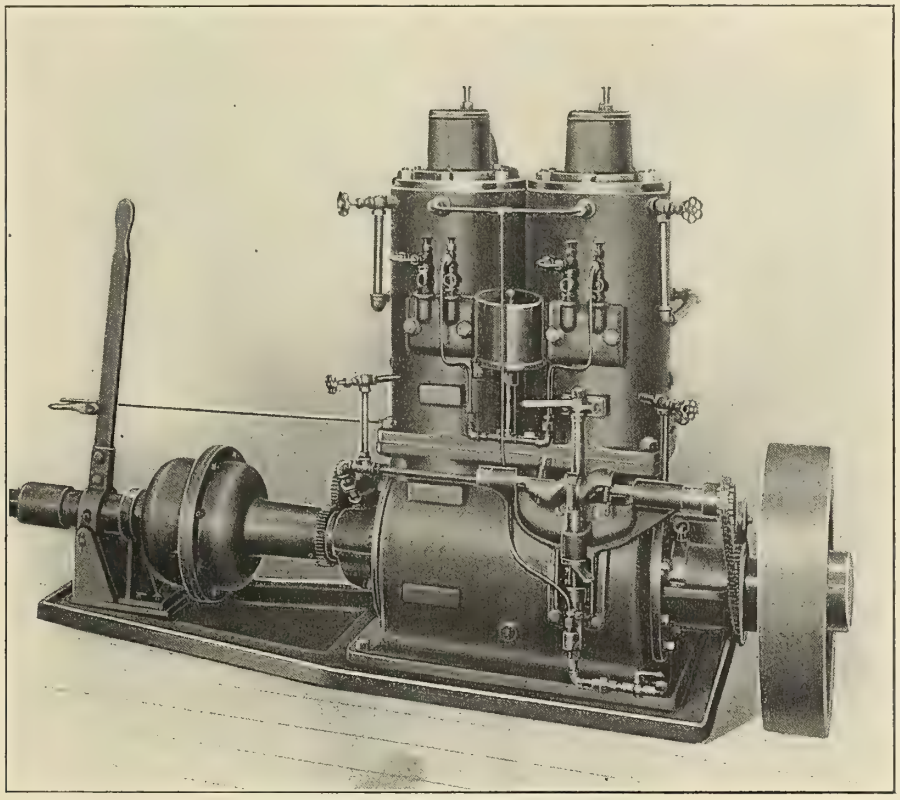


YACHT TENDER MADE OF SHEET STEEL.

Kerosene Marine Engine.

Practically all the oil explosive engines for marine purposes use gasoline fuel. There has, however, been brought out this season by A. Mietz, 128 Mott street, New York, N. Y., a marine type of kerosene engine, built along the same general designs of the stationary Meitz & Weiss kerosene engine, which has for so many years been in successful operation. The accompanying view is of the starboard side of a double cylinder, two cycle, 10-horse-power engine. The method of introducing the fuel is different than in other engines. By means of a small pump driven by a horizontal shaft geared to the main shaft, the kerosene is injected on hot plates at the top of the cylinder just about at the

end of compression. It immediately is vaporized, mixes with the air, and the explosive charge is pressed into a heated cast-iron sphere in communication with the top of the cylinder, which ignites the charge. The exhaust port is placed in the side of the cylinder, and the fresh air compressed in the crank case drives the spent gases



TWO-CYLINDER 10-HORSE-POWER KEROSENE ENGINE.

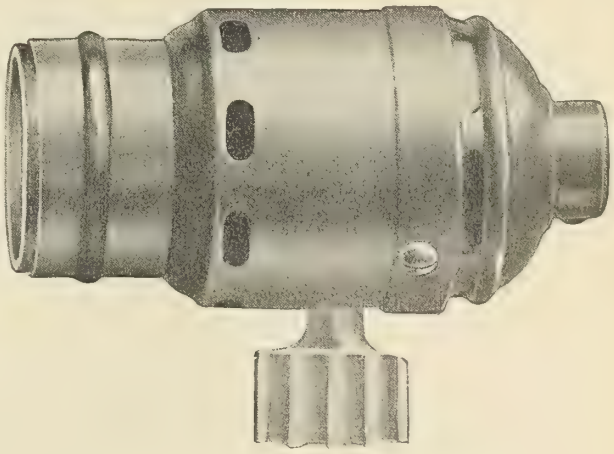
out of the cylinder. On the up-stroke, as soon as the cylinder has passed the exhaust port, the air is compressed and the cycle is repeated.

Regulation is secured on the pump shaft by an inertia governor, which changes the throw of the eccentric operating the kerosene pump. A small amount of water passes into the cylinder to clear out any crust or deposit from the gases. Lubrication is secured from a suction cup, shown between the cylinders. The cylinder walls are thoroughly water jacketed. For starting the engine a pilot flame is used to heat up the igniting sphere, as previously mentioned, but it is stated that after the engine is under way this flame may be extinguished as the sphere, which of course is not water jacketed, is kept hot by the exploding gases.

A special reversing clutch, shown at the left of the illustration, embodies many desirable features for which the makers claim high efficiency and minimum of wear.

Regulating Electric Socket.

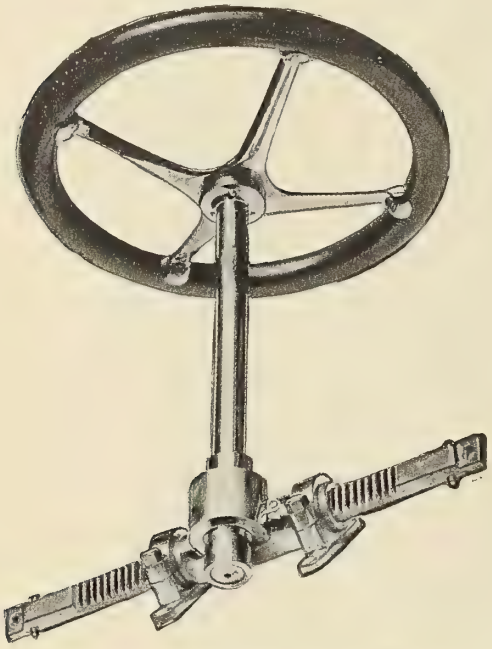
The Borgia regulating socket is an electrical fitting to be used for varying the amount of current delivered to a local circuit, such as a lamp, motor, or electrical heater. The device is inclosed in an outer shell resembling the ordinary incandescent lamp socket, in which is a receptacle containing local terminals fitted for connecting with the terminal plugs of the lamp or motor. The amount of current delivered to these plugs is regulated by a key, by interposing a varied amount of resistance medium. The key, which is similar to that of the ordinary socket, also serves to make and break the connection between the line and local circuit with



ELECTRIC SOCKET FOR REGULATING THE CURRENT.

a spring snap connection. Thus any degree of light may be secured from 1-2 candle power to the full candle power of the lamp attached by simply turning the

key. The socket fits any lamp or fixture, and may be used on a direct or alternating current. With the ordinary socket, of course, it is only possible to have a full light or no light, while with this, any degree of light may be attained and the corresponding amount of current used. As the expense of burning the light depends on the current, with the Borgia socket much saving may be made. This socket is made by William F. Stilz & Company, 720 Arcade Building, Philadelphia, Pa.



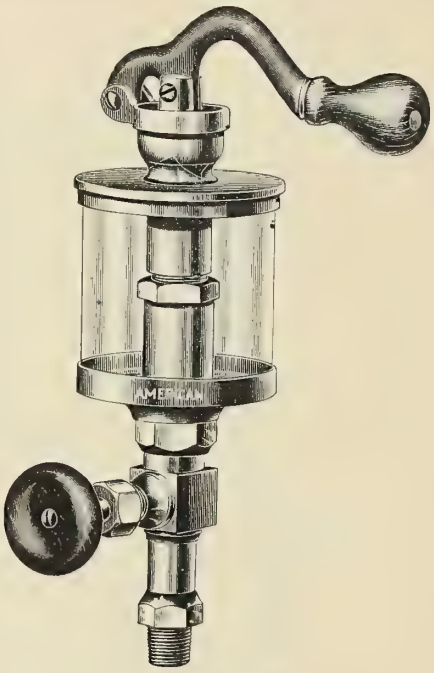
BRASS STEERING WHEEL FOR USE IN AUTO BOATS.

Auto Boat Steering Wheel.

With the advent of the auto boat many special fittings are required novel in boat equipment. Among these is a device for steering somewhat similar to the automobile. The hand-steering wheel made by Charles D. Durkee & Co., 2 and 3 South street, New York, N. Y., here illustrated, is a small, compact wheel which may be placed in the most convenient part of the boat, and may be set for any angle. It is designed for high-speed boats where quick manœuvering is absolutely essential. It has a rack and pinion motion which precludes any slip, bind, or play. All parts are of polished brass, except the wheel rim, which is of mahogany. The wheel is made in two sizes for boats up to 30 feet and boats up to 60 feet in length, while larger sizes are made to order.

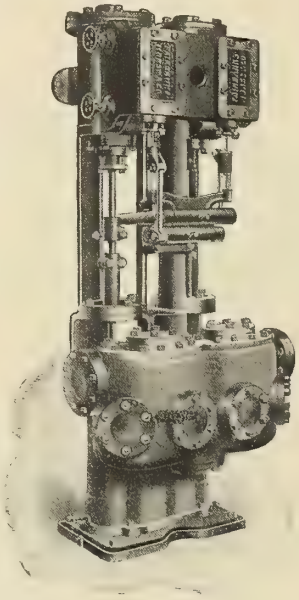
Glass Body Oil Pump.

As a guarantee against the cutting off of the oil supply to important bearings on different types of engines, it is becoming the practice to fit up an auxiliary oil pump. The "Ideal" pump, here illustrated, and made by the American Lubricator Company, Detroit, Mich., is built specially for this purpose. The pump is placed in the middle of the oil cup in line with the pipe connection, and is operated by a lever handle. It is easy to fill and operate, and the glass body shows the amount of oil present at all times. The construction of the pump is claimed to be first class in every respect, and each pump is thoroughly tested before leaving the factory.



HANDY OIL PUMP.

It is made in four sizes, the outside diameter of glasses of the smallest being 2 1-2 inches and of the largest size 4 1-4 inches.



VERTICAL DUPLEX MARINE BOILER FEED PUMP.

Duplex Marine Boiler Feed Pump.

The pump here illustrated is designed with a view of economizing floor space. It is very compact and yet all

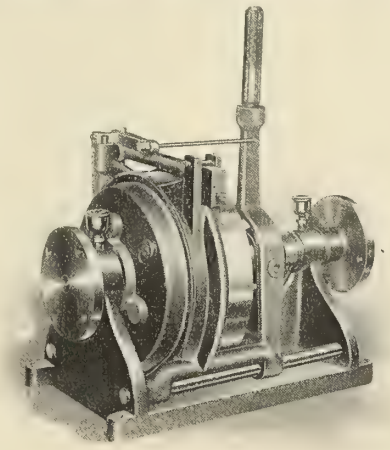
portions are easy of access when it becomes necessary to examine or repair them. The handholes, as shown in the illustration, permit the interior of the pump chambers being easily reached when new valves, springs, or guards are needed. One desirable feature is that the water pistons may be packed through the top of the water box without disturbing either the steam piston or any part of the valve motion.

The valve motion is of the interchangable design, the parts on one side of the pump being exact duplicates of like parts on the opposite side. This is a very desirable feature, requiring that a fewer number of spare parts be carried in stock than would be needed if the design provided for right and left parts, as is the case with many pumps. The steam cylinders are provided with cushion or dash relief valves to assist in securing an even stroke of the machine. The steam chests are in a single casting, bolted directly to the steam cylinder faces, thereby strengthening the steam end. The pumps are manufactured by the Fairbanks, Morse Company, Chicago, Ill., for any pressure up to 200 pounds per square inch.

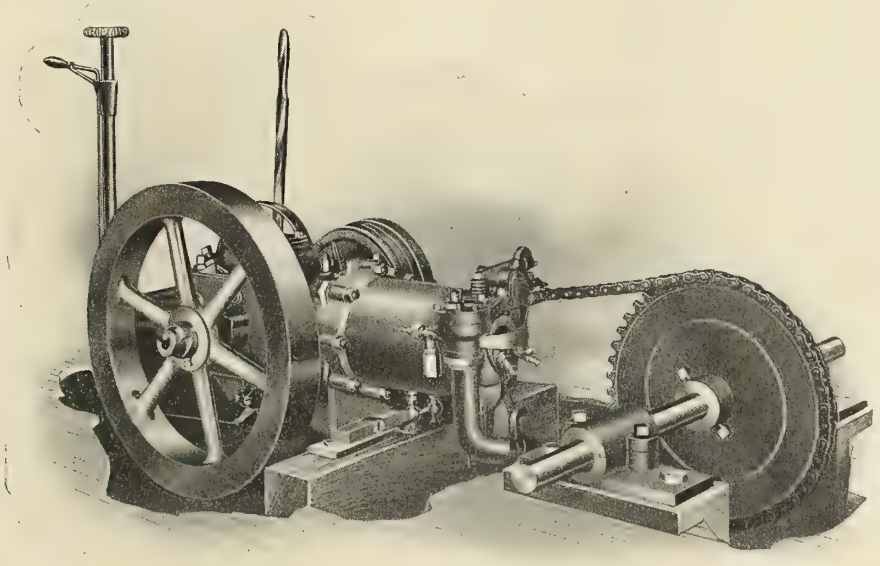
Engine for Paddle-Wheel Boats and Reversing Gear.

An engine here illustrated, brought out recently by the Chas. A. Strelinger Company, of Detroit, Mich., is designed for side or stern wheel boats. The size shown is suitable for boats from 25 to 35 feet in length, although on account of the small space the engine occupies it may be used for smaller vessels and yet by reason of its large power may equally apply to larger boats. In the South and Southwest stationary gasoline engines of the regular horizontal type have been used for driving small paddle wheel boats, but their introduction has been limited first on account of excessive weight, the 4 by 5 H. P sizes ranging from 1,200 to 1,500 pounds, and the 6 to 8 H. P. from 1,500 to 2,500 pounds or even more, and secondly by the rather elaborate system commonly used of clutches, cross belts and jack shaft, which, in many cases, take half or more of the deck space.

The engine shown here will develop 9 brake horse power, occupies less space than the ordinary 2-horse-power stationary engine, and weighs complete, as shown, less than 400 pounds, which permits its being placed at extreme end of stern if desirable. For side-wheelers the driven sprocket may be placed directly on the wheel shaft and driven from sprocket on the engine. In many cases this may be done with stern wheelers, or if for any reason it is deemed expedient or necessary, the paddle wheel may be driven through a countershaft, as shown in the illustration.



REVERSING MECHANISM.



GASOLINE ENGINE FOR PADDLE-WHEEL BOATS.

The Brush mixing valve is used, by means of which the engine may be run for any length of time at any desired speed from full to one-eighth of normal, throttling and reversing may be arranged to handle from practically any part of the boat. Reversing is

accomplished by simply throwing the lever, shown in the illustration at the right hand, backwards or forwards.

The engine is, of course, of the 4-cycle type, extremely simple and unusually reliable, has copper water jacket, no packing to blow out. Crank shaft, connecting rod, gears and many other working parts are steel drop forgings. Workmanship is of the highest possible grade and all parts are interchangeable. Because of strength and silent running, the use of steel roller chains is recommended, but regular sprocket chain may be used.

The reversing mechanism made by this company for propeller shafts is of the spur-gear type. Gears throughout are cut from solid steel drop forgings. It is strong and well built. It is made at present in sizes suitable for engines up to eight horse power, and while neither as small nor as light as many others, it is not as weak.

Engine and Boat Manufacturers Organized.

The National Association of Engine and Boat Manufacturers was formally organized in New York on June 7. The membership roll is signed by forty-four of the leading manufacturers in these lines from all parts of the country. The charter of the Association under the laws of the State of New York, was received and the constitution and by-laws were adopted. Permanent officers are to be elected at the next meeting, until then, Mr. E. W. Graef will act as Secretary.

The objects of the association are in part as follows: To get special freight rates; to establish a bureau of information; to make special arrangements in regard to and to participate in the profits of shows; to protect its members against adverse legislation and questionable advertising schemes; to bring forward the new and improved methods in construction, and to take such action as will be in the interests of its members as regards alcohol as fuel.

The membership of the association is as follows: The Lozier Motor Company, the Standard Motor Construction Company, the Bridgeport Machine and Motor Company, the Gas Engine and Power Company, the American Iron Works Company, the Buffalo Gasoline Motor Company, the Charles A. Strelinger Company, the Toquet Motor Company, Panhard & Lavoussour, the Matthews Boat Company, the Isham Company, Frederic S. Nock, the Delaware River Motor Company, Palmer Brothers, the Standard Boat Company, the E. Gerry Emmons Corporation, Norwood Brothers & Company, the Eagle Bicycle Company, the Cushman Motor Company, the Wolverine Motor Works, Lacy Brothers, the Chase Pulley Company, A. Barrett's Sons, the Pearson Boat Construction Company, Termadt & Monahan, the Truscott Boat Manufacturing Company, the Pierce Engine Company, the White Craft and Power Company, Charles Durkee & Company, the Smalley Motor Compand, Ltd., the Mianus Motor Company, the Outing Boat Company, the Remy Electric Company, William Roche, the Stamford Motor Company, E. W. Graef, the Smith & Mabley Manufacturing Company, the Milton's Point Ship Yards, T. S. & A. D. Negus, the Electric Launch Company, A. Paterson, the *Motor Boat, Motoring and Boating,* and the *Automobile.*

QUERIES AND ANSWERS.

Q. 218 (*a*)—Is there any good reason why float-feed carbureters cannot be successfully used on two-cycle marine motors?

(*b*) Would not a four-bladed propeller wheel give less vibration to a boat than one with three blades?

(*c*) For a heavy boat 26 feet long, 6 feet beam, standing canopy top, one-half of the boat cabined; and a two-cycle, two-cylinder 8-H. P. motor, each cylinder 5 by 5 inches, what should be the size and kind of propeller to be used to obtain maximum speed and minimum vibration?

I think I want an up-to-date, four-bladed propeller and a good foreign-make carburetor; will you not kindly aid an amateur motor-boat man to obtain best practice? M. W. I.

A.—(*a*) There is no reason why a good float-feed carbureter cannot be used on a marine motor.

(*b*) We do not believe the propeller is the cause of the vibration you mention, unless it is not balanced as it should be.

If properly balanced, a three-bladed propeller will run as well as a two or four-bladed one.

(*c*) For the 8-horse-power double-cylinder 4 inches by 5 inches motor, we would recommend a two-bladed propeller 22 inches diameter, 30 inches pitch. If motor is of the usual style, but if a modern high-speed motor, we would advise making the pitch equal to the diameter and speeding up the motor. There are American carbureters that are the equal of any foreign production, and are more reasonable in price. Some American makes will, with one setting of the needle valve, give a constant mixture at all speeds of the motor, even when used on two-cycle motors, and throttling before the mixture enters the crank case. We know of a two-cylinder two-cycle motor using one float-feed carbureter throttling before the charge enters the crank case that can be run from 200 R. P. M. to 2,000 R. P. M. with fixed spark lead, the speed being entirely controlled by the throttle which forms part of the carbureter.

Q. 221.—I have an Ideal compound engine, 11 and 20 inches by 14 inches, running at 294 revolutions per minute, with a 6-foot pulley wheel from which is driven by a belt a 100-Kw. alternating Stanley machine of 2,400 volts. The pulley on the alternator is 20 inches in diameter. Now, can I substitute an 18-inch pulley and slow down the engine to run 232 revolutions and give better results? E. O. M.

A.—Decreasing the diameter of your driven pulley to 18 inches will allow a proportionate decrease of the revolutions of the engine as 18 is to 20, and still run the alternator at the same speed, thus: $294 \times \frac{18}{20} = 264.6$ turns of the engine. Now, whether your engine can carry the full load at this decreased revolutions is something for the engine makers to decide. You have not stated steam pressure, so we cannot advise you.

Q. 225.—Will you please give me definitions of the following terms, keeping your answer as free from technicalities as possible: "Moment of inertia," "Radius of gyration," "Section modulus"?

A.—These terms arise in discussing the mechanical properties of girders, beams, channels, angles, and shipbuilding shapes in general. For standard shipbuilding shapes the quantities are given in tabulated form in the various handbooks published by the leading steel makers. Their complete explanation would be hardly practicable within the limits of space here available, and we must be content with a brief outline of their mechanical character and relation to the strength of the beam or girder.

The effect of a force or load in producing a bending

stress in a beam depends not only on the amount of the force but on the "advantage" or leverage with which it acts. The product of force multiplied by arm or leverage is thus in mechanics shown to be a measure of the effect of the force in producing bending stress in a given beam. This product is known as the *moment* of the force, and the total effect of the external load is the sum of the effects of all its parts, and hence the sum of all the moments, or of the products which are found by multiplying each load by its arm or distance from the particular section, the internal stress in which is under consideration. This sum or measure of the total effect of the external load is then known as the external moment.

This external moment must then be balanced by an internal moment representing the total effect of the internal stresses in opposing or holding against the effect of the external load. Now, it is shown in mechanics that this balance of moments external and internal may be represented by an equation in the form: $M = \frac{p\ I}{y}$, where M represents the external moment and the expression on the right of the sign of equality represents the internal moment. This is built up as shown of three terms, as follows:

p = stress of fiber located at a distance of y from the neutral axis, and if the outermost or farthest fiber is taken, it will then be the greatest stress on the section due to the given load.

I = the moment of inertia of the area of the section about an axis through its neutral axis.

y = distance from neutral axis to the fiber or part of the section in question.

In these definitions we have introduced two terms: *neutral axis* and *moment of inertia,* which themselves need definition, and to which we shall presently come.

When a beam or any member of a structure which acts as a beam is subjected to a cross-breaking load we know that on one side it is thrown into tension and on the other into compression, and we know, furthermore, that these stresses vary with the amount of stretch on one side or compression on the other, as the case may be, and that this stretch or compression is greatest at the extreme outer surfaces of fibers and decreases toward the middle parts of the section. Now, there will be some line lying across the beam section where there is no distortion of the material; a line where the gradually decreasing stretch becomes zero and then changes into a gradually increasing compression. This line is called the *neutral axis,* or, more fully, the neutral axis of the section, and it is shown in mechanics that it passes through the center of gravity of the area of section, and in a direction at right angles to that of the load. Thus, if the load is vertical, as in the case of weights carried, the neutral axis will be horizontal, and is located by finding the center of gravity of the section area and drawing a horizontal line through the same.

The moment of inertia of the area of section about the neutral axis is the sum of an indefinitely large number of partial products, each one of which is formed by multiplying a small element of the area by the square of its distance from the neutral axis. If we suppose the section area cut up into small squares each one-hundredth of an inch square, and thus having an area of .0001 inch, and that each of these areas .0001 square inch is multiplied by the square of its distance from the neutral axis and the products all added, the sum would give a close approximation to the moment of inertia. If, then, we can imagine this process of division of the area carried still further until the number of elements becomes indefinitely large and the area of each one indefinitely small, then, with such subdivision, the sum found by carrying out the operations of multiplication by the square of the distance and addition would give the moment of inertia as used in mechanics. Actually, it is not necessary to find the moment of inertia by any such method as indicated above, as there are methods provided by higher mathematics for readily finding the sum of such an indefinite series of indefinitely small quantities.

If, now, we divide the moment of inertia by the area as a whole, we shall get a mean square of all the arms or distances entering into the final sum. This is readily seen when we note that each partial sum is a product of an element of the area by the square of its arm. If then we divide the sum of such a series of terms by the whole area, the quotient will give the average or mean of all these squares. This average square is then known as the square of the radius of the gyration, and the *radius of gyration* is the square root of the average square. The radius of gyration is thus seen to be a kind of mean arm, but found by taking the square root of the average square. Individually it is not of great significance, and becomes of importance chiefly as a factor or part of the moment of inertia in the strength equation given above.

The *section modulus* is a name given to the quotient of $I \div y$, the moment of inertia, divided by the distance from the outer fiber to the neutral axis; or, in other words, it is the value of the external moment which the beam will support per pound of unit stress at the outer fiber. Thus, if a section modulus is 3 it means that the beam will stand an external moment of 3 for every pound of unit stress on the outer fiber, and hence if 10,000 pounds per square inch may be allowed, then an external moment of $3 \times 10{,}000 = 30{,}000$ inch-pounds may be carried with a developed stress of this value. What this means in terms of load will depend on the length of beam and manner of loading. Thus, if the beam is fixed at one end and loaded at the other, the external moment at the root of the beam where the stress is maximum is the product of the load by length, pounds and inches being the units to be used. Hence, in the case above, a load of 1,000 pounds at an arm of 30 inches, or 500 pounds at 60 inches, or 200 pounds at 150 inches, or any other such combination, would be safely carried. If the beam is supported at both ends and loaded in the middle, then as shown in mechanics the maximum moment will be relatively one-fourth its value in the case just taken, and hence the product of the length by weight at the middle in such case will be 120,000 inch-pounds, and the adjustment between load and length may be anything giving this product. With a beam supported at each end and uniformly loaded throughout its length, the maximum moment will be one-eighth that in the case first taken, and hence the product of total load and length in such case will be 240,000 inch-pounds, and length and total load may be adjusted accordingly. Still other cases may arise, but further

discussion of these points would require more space than can be here provided.

Q. 227.—In the case of a boiler already at work, the escaping gases are found to be about 700 degrees F. I wish to know the proper changes to make to reduce the temperature to what is considered proper, say 500 degress. Also how is the saving gained by the reduction estimated?

A.—With information given it is practically impossible to give any definite answer. It will, therefore, be best to take an assumed case to illustrate the reason for the saving and the method of estimating.

Let us assume a Scotch boiler with 70 square feet of grate surface, working under forced draft and burning 25 pounds of coal per square foot per hour; or 1750 pounds total per hour. In order to burn this coal air must be admitted under and above the grates, the theoretical amount being about 12 pounds per pound of good coal. Actually, however, the necessary amount is far in excess, two or three times the theoretical. With forced draft the excess air required is not as great as with natural draft and in this case we can assume that 25 pounds of air are required per pound of coal, or a total of 43,775 pounds of air must be supplied per hour. The weight of gas passing up the chimney then will be the weight of air plus the weight of coal less the weight of ashes, the ashes are so slight, however, we can omit them in this calculation. We have for the pounds of gas per hour 45,500 or 758 pounds per minute. The specific heat of this gas can be assumed to be .238. Therefore, the British thermal units per degree temperature are $758 \times .238 = 180.1$.

The temperature, as you stated, viz.: 700 degrees, we assumed to be taken at the base of the stack. This is exceedingly high and must be the result of forcing the boiler too hard, not providing sufficient combustion chamber, not having sufficient heating surface in the tubes, or inefficient heating surface. As stated, it is impossible to give a reason for this high temperature without knowing full particulars of the specific case. We will continue with the problem, however, and assume that by some means or other, the gases will be reduced 200 degrees and this heat returned to the boiler.

With 180 B. T. U. per minute for each degree of temperature a reduction of 200 degrees will represent 36,000 B. T. U. To obtain this with a boiler of an efficiency of 70 per cent. would mean the burning of $\frac{36{,}000}{14.000 \times .70}$ or 3.7 pounds. This is equivalent to 220 pounds per hour, or 12.7 per cent. of the total coal burned, an amount well worth endeavoring to save.

With mechanical draft there are two ways in which excessive flue temperatures may be reduced.

One by the Howded system of forced draft, and the other by the Ellis & Eaves system of induced draft. In both of these air heaters are placed in the smoke boxes through which the entering air to the boilers passes and is heated by the exhaust gases. In the first named system the fan drives the air from the heater and into the boiler; in the Ellis & Eaves system, the air is *drawn* through the heater and boiler by the fan which is placed at the base of the stack.

Q. 228.—In the article by Professor Rateau, in your June issue, occurs this statement: "The speed of the turbine must be reduced in proportion to the speed of the ship . . . while the power diminishes approximately as the inverse of the cube of the speed." Will you kindly explain this last statement if it is correct? R. S. R.

A.—The statement would be more correct in the form, "while the power diminishes approximately as the cube of the speed," thus omitting "inverse of the." The statement in this modified form is plainly what is intended, and simply means that the power for steamships varies very nearly as the cube of the speed. This is again a direct result of the fact that resistance varies nearly as the square of the speed, and hence power which represents the product of resistance by speed must vary nearly as the cube of the speed.

Q. 229.—I would like to use the constants in the two following formulas in an example, and therefore ask you to explain how they are derived. Both formulas are for the collapsing pressure of boiler tubes.

1. $P = \frac{9{,}675{,}600 \times t^2}{l \times d}$.

2. $P = \frac{89{,}600 \times t^2}{L \times d}$.

Where t = thickness of plate,
l = length of tube in inches,
L = length of tube in feet,
d = diameter in inches.

W. E. J.

A.—The second formula is derived from the first and is recommended by Lloyd's Register and the U. S. Board of Supervising Inspectors of Steamboats. It is derived by placing the length of the tube in feet instead of inches and by introducing a factor of safety of 9. Thus the constant is reduced by $9 \times 12 = 108$.

The first formula is mostly empirical, derived by Sir Wm. Fairbairn, as a result of extensive experiments on tubes ranging from 4 to 12 inches in diameter and in length from 19 to 60 inches. In some cases further limits are fixed on its application by supplementary formula; but it is generally accepted as the basis for all rules for ascertaining strength of boiler flues. The results of Fairbairn's tests are given in Philadelphia Transactions of 1858.

OBITUARY.

Merchant & Company, Incorporated, Philadelphia, announces with profound sorrow the death of its president, Mr. Clarke Merchant, formerly lieutenant in U. S. N., who died on May 7.

John Riley, for fifteen years president of the United States Metallic Packing Company, died at his home in Philadelphia on April 19, this year, in his seventieth year. Mr. Riley was born in central Pennsylvania, and in his early life took up railroad work. For thirty-one years he was with the Pennsylvania Railroad Company, where he rose to the position of superintendent of transportation. In the early eighties he resigned from this company and associated himself with the United States Metallic Packing Company, where he was held in the highest esteem by officers and employees.

TECHNICAL PUBLICATIONS.

Naval Architecture. By Professor Cecil H. Peabody. Size 6 by 9 inches. Pp. 616, with 218 figures in the text. New York: John Wiley & Sons. Price $7.50.

The purpose of the author in the preparation of this work has been to give in a consistent and connected form the commonly accepted theory of naval architecture. The parts having more immediate relation to the needs of ordinary office work, such as the computations relating to geometrical quantities, stability, propulsion, and strength, are developed in relatively direct and simple form, while of necessity the treatment of waves and rolling is somewhat more intricate. The work as a whole is divided into fourteen chapters as follows:

Chapter I deals with the general subject of integration, both by arithmetical and mechanical processes. A discussion and comparison of various rules for approximate integration is given, together with an explanation of the theory of the more common integrating instruments. The effort toward simplicity has been perhaps too plainly apparent here, and for the needs of the student of the subject a somewhat broader mathematical treatment of several topics in this chapter might be desired. In Chapter II the subjects of displacement and center of buoyancy are discussed, or in general the problems relating to volume, centers of volume, and the allied computation for meta-center. These are discussed relative to various rules for integration and are accompanied by sample forms and computations, showing the application of the methods to actual cases. Chapter III deals with the elementary theory of stability and with a discussion of several methods of computation intended for the usual drawing office investigation of this item. It is followed in Chapter IV by a more generalized treatment of the equilibrium of a floating body, in which the matter is presented from the geometrical viewpoint, with a discussion of the problem of stability in its broader aspects. Chapter V gives a discussion of the simpler problems connected with added or shifted weights on a ship and in particular as regards their effect on the position of equilibrium and on the stability. The same discussion naturally gives an opportunity for discussing the inclining experiment, as well as the influence of liquid cargoes on stability, and the steps needful to secure with such cargoes any desired safe margin. In Chapters VI and VII the somewhat allied topics of grounding, docking and launching are discussed. The computations needful in connection with the latter are discussed, as well as the special questions of stability, load at points on the bottom of the ship, &c., which may arise in connection with these matters. In Chapter VIII the theory of waves is presented to such an extent as is believed to be needful for the purposes of the naval architect. An explanation is given of the constitution and propagation of trochoidal waves on the basis of the approximate or arbitrary assumptions usually made for the elementary treatment of this subject. From this initial point the properties of ocean waves are developed and discussed with special reference to the problems presented to the naval architect and ship captain. The discussion of deep sea waves is followed by a briefer presentation of the subject of shallow water and solitary waves, with especial reference to the differences between these and deep sea waves, and with a brief discussion of the formation of groups of waves and of the group properties. This is naturally followed in Chapter IX by a discussion of the rolling of ships. This is presented by the aid of the usual mathematical equations, which are discussed with reference to both free and unresisted rolling. Only the more simple cases are dealt with, and while the author has in both Chapters VIII and IX used higher mathematics with some freedom, there has been an obvious attempt to limit such use to the lowest amount consistent with some breadth of treatment. It thus results that the discussion is far from complete in many points, and the thorough student of this phase of the subject should consult more specialized works for further important particulars relating to the subject matter of these chapters. In Chapter X the author takes up the general subject of resistance, introducing the discussion with the time honored topic of stream lines and stream line motion, though, naturally, but little later use can be made of the matter thus developed. Approaching the subject from the standpoint of actual observation, the classical experiments of Froude and others are described and their results summarized, and the usual discussion is given of resistance and its constituent parts, skin or frictional resistance and wave or residual resistance. A brief presentation is then given of the law of mechanical similitude and its application to the development of a relation between the residual resistances of geometrically similar ships at "corresponding" speeds.

Chapter XI follows, naturally, with a discussion of the propulsion of ships. The paddle wheel and screw propeller are taken up from the empirical viewpoint, the experiments of Froude furnishing the data for most of the discussion relative to the latter. Methods of propeller design are also discussed, undue weight being perhaps given to methods involving considerable analytical refinement and complexity. In Chapter XII the subject of the power needed to propel a ship at a given speed is taken under discussion from the viewpoints developed in the preceding chapters on resistance and propulsion. The various methods by independent estimate, by comparison, and by the use of the Admiralty and other similar formulæ are discussed and the relations of the methods by Admiralty and like formulæ to the method by comparison are explained and illustrated. In Chapter XIII the subject of steering and manœuvering is discussed relative to the usual approximate theory of the action of the rudder, the resulting path of the ship, as a whole when turning under the influence of the rudder is developed, and the relation of these various matters to the manœuvering characteristics of the ship is explained. In the last Chapter, XIV, the general subject of the strength of a ship is considered with reference to longitudinal stress, and as resulting from the irregular distribution of both weight and buoyancy from one end of the ship to the other. This is supplemented further by a discussion of the strength of a bulk head as determined by the size and distribution of the stiffening material.

The book, as a whole, forms a notable contribution to the literature of theoretical naval architecture, and should prove of value to all students of the subject.

Steam Boilers; Their Theory and Design. By H. de B. Parsons. Size 6 by 9 inches. Pp. 375, with 155 figures in the text. London and New York: Longmans, Green & Company. Price $4.00.

This book comes to fill a decided gap in the technical literature of the day. Between the steam boiler and the steam engine, the two parts of the equipment necessary for the transformation of coal energy into mechanical work, authors have, perhaps, given undue attention to the engine; or, in any event, there is much more literature available regarding the engine than the boiler, both in relation to the practical and theoretical aspects of design, construction, and operation. In the present work the author has proposed to cover this general field for the boiler as it is found in the present engineering practice of the day. The work is divided into sixteen chapters covering the general topics of heat, combustion, fuels, efficiency, boiler performance, draft, materials, detailed design, fittings, stokers, incrustation, corrosion, explosions, chimney design, smoke prevention, testing, operation, and care.

The treatment of the subject throughout is clear, well balanced, and accurate. In the theoretical portions the author has given only such elementary and general discussion as may best serve for a good foundation for an intelligent study of the subject. Many special topics have been quite properly passed over as not coming within the intended scope of the work, but the matter given under this general head will be found, for the most part, to cover the requirements of the engineering student of the subject, and to serve for the general reader as collateral to such specialized works on mechanics and physics as give more extended theoretical treatment of these allied branches.

Thus, in the opening chapters, a brief discussion is given of the general properties of matter, with especial reference to heat and changes of state due to addition or subtraction of heat, followed by the theory of combustion, with formulæ and illustrative examples relating to the total heat of combustion for fuels of various grades and compositions. In connection with the design of boilers, only so much of mechanics is introduced as may serve to intelligently discuss the formulæ employed. In the discussion of riveted joints this simplicity is perhaps carried too far and the reader is left without adequate formulæ or suggestion regarding the proper proportions for the design of modern boiler joints of the highest efficiency.

On the practical side the treatment of the subject is more adequate, and it is clear that it is to this aspect of the subject that the author has intended to give his principal attention. A large amount of useful information is given regarding fuels and the conditions for proper combustion, regarding the points to be held in view in boiler design, regarding the materials available for the construction of boilers, regarding auxiliaries and fittings, draft, stokers, operation, management, etc.

Under the general head of design the discussion of the various governmental and "classification" rules is especially full, as it deservedly should be, since most modern boilers are designed structurally with reference to some such set of rules and requirements.

The treatment is clear, the material well selected, and the author has succeeded admirably in bringing together a well balanced and instructive manual on the modern steam boiler with especial reference to the practical aspects of the many problems which its design and operation may present.

It will find a most acceptable place in the working library of all steam engineers and those interested in steam engineering, and to all such it is most cordially commended.

Entropy or Thermodynamics from an Engineer's Standpoint. By James Swinburne. Size 5 by 7 inches. Pp. 137, with diagrams in the text. New York: E. P. Dutton & Company. Price $1.25.

According to the author the reason for adding another book on thermodynamics to those already in existence is because it is wanted, and it is clear that the author believes himself foreordained to fill this want. The chief purpose of the book is professedly to correct the erroneous notions regarding entropy, which are, according to the author, almost universally prevalent, and to explain the true nature of this physical concept from the practical engineering point of view. To quote from the author's preface: "As far as I am aware there is not any work on the steam or gas engine in this country (England) that gives a correct definition of entropy . . . and when it is added that most treatises on physics, English and foreign, contain incorrect definitions of entropy, and that even some of those specially on thermodynamics are at fault, especially in classing entropy as a factor of heat, there is no need for any apology, at least, for the appearance of a book like this."

When we consider the progress in applied thermodynamics, as shown in the improvements in steam and gas engines during the past 30 years, or covering the period when most of the literature referred to has appeared, we are forced to the conclusion that, sad as is the picture painted by the author regarding the misconceptions relating to entropy, it has had but little effect on the practical progress in the perfection of heat engines, and that in consequence either such practical progress has little dependance on the conceptions of entropy or else the misconceptions have not been so widely spread or so serious as the present author believes. It is probable that there is foundation for both of these views. It is, of course, to be desired that there should be no misconception regarding any subject connected with either theoretical or applied thermodynamics, but it is none the less true that those who have had most to do with the practical improvement of the steam and gas engine have, as a rule, reached their results by methods which did not involve in any marked degree the consideration of the nature of entropy. They were able to reach ultimate truth by other paths and only in an indirect way would entropy or a consideration of its nature enter into their treatment of the problems of applied thermodynamics. On the other hand, it is hardly likely that the misconceptions which this book is to set right have been so serious or so widespread as the author believes. The main burden of the author's treatment seems to relate to the fact that entropy and entropy

relations, as usually stated, are correct only for reversible processes, while most processes with which the engineer has to deal with are irreversible, and the application of entropy relations, and, in particular, the use of the temperature-entropy diagram, requires special modification in dealing with processes of this nature.

It is true that there has been misstatements regarding these matters in the literature of both pure and applied thermodynamics, and authors have not always been as careful as they should have been in discussing irreversible operations by means of methods only strictly applicable to reversible operations. We can scarcely believe, however, that the authors of these various articles and discussions have been ignorant of the limitations of the methods which they may have employed, or that engineers have been to any serious extent led astray in their practical work by such looseness of writing. This is in no wise intended as an excuse for loose writing or for the existence of loosely expressed ideas on engineering or physical science, and we heartily agree with the author that there is room for a full, clear, and authoritative treatment of this subject which might be accepted as final and definitive with regard to the theoretical aspects of this subject and its general relation to practical thermodynamics.

We fear, however, that the present work will hardly meet these specifications. The author's style is obscure and at times confused, if not contradictory. Words are used in more than one significance without due explanation, special and individual points of view are introduced as well as special uses of well-known terms, and without due explanation for the reader. It may be perhaps said that giving the author the benefit of every doubt as to his own ultimate meaning, his views may be considered as in fundamental agreement with the historic development of the subject. It would be no difficult task, however, by taking superficial and perhaps apparent meanings to show him hopelessly at variance with hitherto accepted views and with himself as well.

No such book is likely to exert any serious influence on the development of thermodynamics either pure or applied, and it may be questioned whether the end which the author proposed to himself will be sensibly advanced by his contribution to the subject. If practical engineers or those not already well founded in the subject desire to learn regarding the nature of the entropy concept and its relation to thermodynamic theory, we can hardly advise them to attempt to do so by a perusal of this work.

Logarithms for Beginners. By Charles N. Pickworth. Size 5 by 7 inches. Pp. 43, with tables of four-place logarithms. D. Van Nostrand Company, New York and London. Price 50 cents.

With the increasing use of exponential and other complex formulæ in the calculations relating to all branches of engineering, and especially in thermodynamics, electrical engineering, hydraulics, and marine construction, it is clear that logarithms should be familiar to the modern engineer as a tool of every-day use. The ordinary algebra and the ordinary courses in mathematics in our high schools, and even in our best colleges, are seriously lacking in their treatment of logarithms, and especially from the practical and work-a-day view point. It is to remedy this condition that the author of the present work has prepared this clear and practical presentation of the subject. The author is already well and favorably known by his convenient book on the slide rule, likewise a method of computing by the *mechanical* application of the principles of logarithms. He has now added, in the present work, a more general and detailed discussion of the principles of logarithms with illustrations of their application to various engineering problems. The discussion of the logarithms of fractions is especially good and should aid in clearing up in the mind of the average student or worker with logarithms much of the haze which surrounds their application to numbers less than unity. The illustrative examples are numerous and cover the ground of the usual computations which the engineer is called on to make. A short chapter is given at the close of the book on hyperbolic or Naperian logarithms, showing their character and the manner of obtaining them by transformation from the common logarithm.

The book is written in the clear and simple style which has given such well-deserved popularity to the author of the book on the slide rule, and the present work may properly serve as a complement to the former, the two furnishing together a complete practical discussion of the use of logarithms, one by mechanical and the other by numerical means.

The Metric Fallacy. By Frederick H. Halsey, and **The Metric Failure in the Textile Industry.** By Samuel S. Dale. Size 6 by 9 inches. Pp. 231. New York: D. Van Nostrand Company. Price $1.00.

This book is the outgrowth of a paper presented to the American Society of Mechanical Engineers in 1902, and of the discussion which followed. Part II. has been rewritten and Part I. has been revised and supplemented by additional matter. Part I. deals with the subject from the general viewpoint and includes a discussion of the arguments pro and con regarding the introduction of the metric system, the persistence of old units in various "metric" countries, reasons for the failure of compulsory laws, the industrial loss due to the abandonment of mechanical standards and drawings consequent upon the adoption of the metric system, the "confusion" of the present system of weights and measures, and the claims of superiority for the metric system.

Part II. deals with the application of the metric system in a single branch of industry, and discusses its lack of adaptation to the practical demands in that industry, showing the confusion of old and new standards and units in the present metric countries with reference to textiles and their manufacture.

The authors write vigorously, and as advocates of the superiority of the present system rather than as calm exponents of the two systems, with the choice of selection left to the reader. However great may be the advantages of the metric system for the scientist, and however widely workers in pure science may have adopted such system, it is none the less true that the consensus of opinion among engineers is entirely opposed to the compulsory adoption of the metric system, and that they are in overwhelming proportion agreed on the greater all around practical applicability of our present system to the needs of industry and practical engineering work. The present book is a clear and well written presenta-

tion of the subject matter from this viewpoint, and will take its place as an important contribution to the somewhat rapidly increasing literature of this subject.

The Army and Fleet of Japan. Size 5 by 8 inches. Pp. 58. Paper covers. Paris: Berger, Levrault & Co. Price .75 francs.

This pamphlet is intended to give the most extended and accurate information possible regarding the composition and organization of the land and naval forces of Japan. The work seems to have been done with the greatest care, and, wherever possible, from official sources. Wherever convenient, the information is thrown into tabular form, and a vast amount of information is given regarding the composition, organization, recruiting, and equipment of the two branches of the service, accompanied by lists of naval vessels, with chief particulars, etc. For the technical student of the present war between Japan and Russia this work should prove of great value, as well as to all who may desire the most accurate knowledge obtainable regarding the military and naval forces which Japan has at her disposal.

The Army and Fleet of Russia, with appendix on the Russian Army in Manchuria. Size 5 by 8 inches. Pp. 112. Paper covers. Paris: Berger, Levrault & Co. Price 2 francs.

This work, which is intended as a companion study to "The Army and Fleet of Japan," is also prepared from official and authentic sources, and gives the best possible information regarding the effective military and naval strength of Russia, with especial reference to the present war with Japan. A comprehensive presentation is given of the organization and administration of the army, with such details as would be of most value in estimating its effective fighting strength. The effective strength of the navy is presented in a similar manner, with a tabular showing of the leading characteristics of the Vessels of the Russian navy. The appendix discusses the Russian army in Manchuria and gives the most reliable information and estimates regarding its composition and effective strength. The work, as a whole, seems to be a carefully made special study into this matter of so much present importance, and will be of interest and value to all special students of the present war in the Orient.

Annual Report from Cramp's Shipyard.—President Henry S. Grove of the Wm. Cramp & Sons Ship and Engine Building Company, states in the company's report for the year ending April 30, 1904, that the income for the year shows net earnings from all the company's operations and interests was $188,174.31, most of which has gone toward the liquidation of indebtedness on the company's property. The progress of work in the shipyard has been satisfactory, although there has been little or no profit in shipbuilding proper. The subsidiary companies have earned the profits. There is no new work in immediate sight, but the company's position is safe for the coming fiscal year, as work in all departments amounting to $13,000,000 is now under contract, which is an increase of $1,500,000 for the same period of last year.

SELECTED MARINE PATENTS.

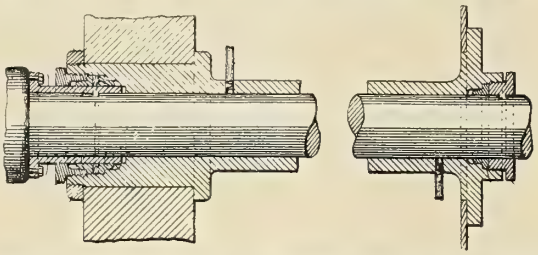
758,656. PILE. GEORGE W. JACKSON AND CORNELIUS HOGAN, CHICAGO, ILL. One claim.

758,841. PROTECTED PILE. CHARLES W. KENNON, TAMPA, FLA. Two claims.

758,983. PROPELLING MECHANISM FOR BOATS. BENJAMIN J. LAVIGN, NEW YORK, N. Y. One claim.

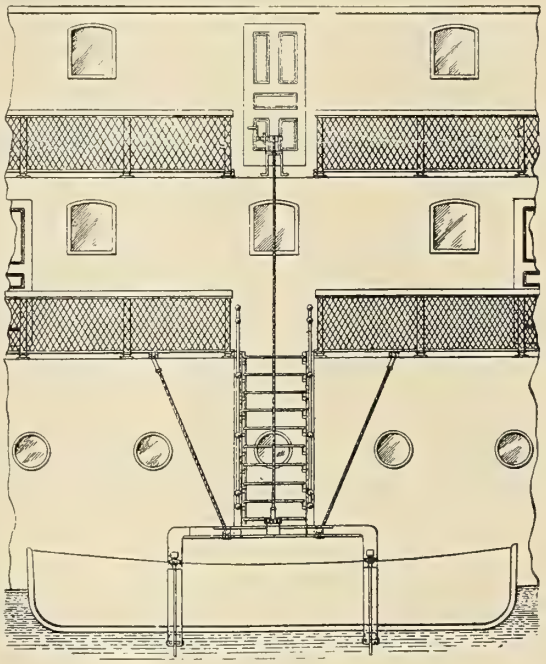
759,238. PADDLE WHEEL. EPHRAIEM CHAQUETTE, NEW ROCHELLE, N. Y. Two claims.

759,323. STERN TUBE FOR SCREW PROPELLER SHAFTS. JAMES STEPHENS, STONEHOUSE, ENG.



Claim.—The outer tube in conjunction with the metal sleeve attached to the propeller boss, the U or hat-shaped packing rings of leather or other suitable material, and the nuts for securing the same substantially as and for the purpose specified. One claim.

759,340. BOAT-LAUNCHING APPARATUS. JACOB BRAUCHLI, HAMPTON, VA.



Claim.—In a boat-launching and life-saving apparatus, the combination of a frame or ladder adapted to be hinged at one end to a ship or other support, a cradle at the other end of said frame or ladder, and means for securing a boat on said cradle. Eight claims.

759,536. NAVIGABLE VESSEL. CAREY A. MANKER, PEARL, ILL.

Claim.—The combination with a vessel keel of a screw propeller having its blades on the upward stroke shielded by a part of said vessel keel and on the remainder of the stroke unshielded, substantially as and for the purpose set forth. Six claims.

759,604. WATER-POWER MOTOR OR ENGINE. THOS. E. FRIKE, COATSBURG, ILL. One claim.

The Engineering Press.—The success of the *Index of the Technical Press* has warranted the publisher to make very great improvements in the character of the paper, beginning with the April number, which was the first issue of the second year of publication. Besides the pages of the magazine have been doubled, and, in addition to the résumés, the *Index* contains a review of the leading engineering question of the month, and many other important features.